Engineering Library

JUL 30 1926

Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLII.—No. 3679] LONDON: FRIDAY EVENING, JULY 16, 1926 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Timbering of Trenches and Shafts—No. I.
(C. G. KENT.) THE ENGINEER, 16 - 7 - 26.

The Royal Agricultural Show—No. II.
THE ENGINEER, 16 - 7 - 26.

Man and Machines.
THE ENGINEER, 16 - 7 - 26.

New Coal-Handling Plant at Beckton.
THE ENGINEER, 16 - 7 - 26.

Inland Navigation Exhibition.
THE ENGINEER, 16 - 7 - 26.

Leeds Tercentenary.
THE ENGINEER, 16 - 7 - 26.

Production and the Production Engineer (No. II.).
(G. W. TRIPP.) THE ENGINEER, 16 - 7 - 26.

The Moffat Tunnel, U.S.A.—No. III.
THE ENGINEER, 16 - 7 - 26.

A New Phase-Advancer.
THE ENGINEER, 16 - 7 - 26.

A Simple Oil Fuel Burner.
THE ENGINEER, 16 - 7 - 26.

PUBLIC NOTICES

G.I.P. RLY. ELECTRIFICATION.

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
POWER STATION SWITCHGEAR AND AUXILIARY PLANT.
Tenders due Friday, 10th September, 1926, not later than 2 p.m.
Specifications and forms of Tender obtainable from the above at a fee of 20s., which will not be returned. 2907

Assistant Engineers (5) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other diplomas or distinction in engineering as the Secretary of State may decide in any particular case or have completed articles with a civil engineer of good standing, and have passed the Examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/14378. 2847

Assistant Engineers (6) REQUIRED by the GOVERNMENT of NIGERIA for the Public Works Department for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 30 years of age, unmarried, must have passed the examination for A.M.I.C.E. or possess a degree in civil engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. They must have proper technical training, and preferably have had not less than two years' subsequent experience on large engineering or municipal works. Candidates possessing other civil engineering qualifications may apply.—Applications should be made at once, by letter, stating age, qualifications, and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14485. 2918

Assistant Mechanical and ELECTRICAL ENGINEER REQUIRED for Iraq. Qualifications A.M.I.E.E. or A.M.I.M.E., with 5 years' general engineering workshop experience, knowledge workshop organisation, experience operation internal combustion engine, electric generation, A.C. and D.C., and water pumping machinery. Salary £250 by £15 annually to £450 plus bonus (inclusive £377 to £432), with foreign service allowance per month Rupees 500 married, Rupees 325 single. Passage and free quarters Preference ex-Service men.—Apply, SECRETARY (W.B.5), Air Ministry, Kingsway. 2919

University College of Swansea.
(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES).
APPLIED SCIENCE DEPARTMENTS.
ENGINEERING.
Professor : FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering : R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering : A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer : J. SELWYN CASWELL, A.M.I. Mech. E.
METALLURGY.
Professor : C. A. EDWARDS, D.Sc. (Manchester).
Lecturer : A. L. NORBURY, M.Sc. (Manchester).
Assistant Lecturers : L. B. PFEIL, M.Sc. (Lond.), A.F.S.M.
P. M. MACNAIR, Ph.D. (Sheffield), B.Sc. (Glasgow).
The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to works of practical educational value to the Students.
Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy, and (2) for Diplomas of the College in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy.
Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such Classes.
Entrance Scholarships will be offered for competition in September, 1926.
Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.
EDWIN DREW, Registrar.
Singleton Park, Swansea. 2923

Crystal Palace School of Practical Engineering.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT : J. W. WILSON, M.I.C.E., M.I.M.E.,
PRINCIPAL : MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 2731

PUBLIC NOTICES

University of Leeds.
DEPARTMENT OF ENGINEERING.
The Council will shortly proceed to the APPOINTMENT of TWO DEMONSTRATORS in CIVIL and MECHANICAL ENGINEERING, at a salary of £300 in each case.
Further particulars may be obtained from the REGISTRAR, The University, Leeds, who will receive applications up to the 28th July. 2852

Borough of Bridlington.
EXTENSIONS TO ELECTRICITY WORKS.
The Bridlington Town Council invite TENDERS for the SUPPLY, DELIVERY, and ERECTION in their Electricity Works at Brett-street, Bridlington, of the following :—
SPECIFICATION No. 6.—ONE SURFACE CONDENSER with EXTRACTION PLANT and CIRCULATING PUMP, PIPE WORK and VALVES, to work in conjunction with a 600 K.W. Turbine.
SPECIFICATION No. 7.—ONE WOODEN COOLING TOWER, with TANK and FOUNDATIONS, to work in conjunction with the 600 K.W. Condensing Plant referred to above under Specification No. 6.
Copies of the specifications can be seen at and obtained from the offices of Messrs. Kennedy and Donkin, 8, Broadway, Westminster, S.W. 1, on and after Monday, 19th July, upon payment of a deposit of £2 2s. per specification (cheque, postal order or money order). Additional copies of either specification can be obtained upon payment of a deposit of £1 1s. per specification. These deposits will be returned after the receipt of a bona fide Tender and on the return of the specification.
Tenders, on the prescribed form, enclosed in sealed envelopes, and addressed on the outside "Extensions to Electricity Works : Tender to Specification No. 6 (or 7)," must be delivered at the office of the undersigned by not later than Friday, 6th August, 1926.
The Council do not bind themselves to accept the lowest or any Tender.
GEORGE MELVIN, Town Clerk.
Town Hall, Bridlington,
9th July, 1926. 2891

The Madras and Southern MAHRATTA RAILWAY COMPANY, Ltd., 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for—
TEN CRANEWAY GIRDERS, complete with Rails and Bolts (a total estimated weight of 81 tons).
Tenders are due in on 10th August, 1926, by 2 p.m. Tender forms obtainable at above address. Fee One Guinea, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 2925

PUBLIC NOTICES

The Yarrow and the William LINDLEY SCHOLARSHIPS.
The Council of the Institution of Civil Engineers are prepared to consider APPLICATIONS for APPOINTMENT to the above SCHOLARSHIPS. These should be submitted before the 18th September, 1926, to the SECRETARY of the Institution at Great George-street, Westminster, S.W. 1, from whom the detailed regulations may be had on application.
The Yarrow Scholars must be British subjects who are not more than 23 years of age and who, desiring to become Engineers, lack sufficient means to enable them to pursue their practical training or their scientific education. The Scholarships are of values from £50-£100 per annum for one, two, or three years.
The William Lindley Scholarships are open to children (not more than 23 years of age) of Corporate Members of the Institution whose means are inadequate to defray all the expenses incidental to an engineering training. They provide for (a) a major scholarship of £80 per annum for engineering study at Cambridge University, tenable for three years ; and (b) a scholarship of £40 per annum for scientific education or practical training in engineering. 2788

SITUATIONS OPEN
COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by MINING CO. in the East, CHIEF ELECTRICAL ENGINEER. Associate or Member of I.E.E., to Take Charge of Power Station (Steam Turbines), High-tension Transmission System, Transforming Plant, Motors, &c. Age about 35. Three years' agreement, passage out and home, free quarters. Salary £900 per annum.—Applications, with full particulars training and experience, references and copies of testimonials, to Box 512, c/o Hooper and Batty, Ltd., 15, Walbrook, London, E.C. 4. 2893 A

WANTED, Experienced GENERAL ENGINEERING SECTION LEADER in Drawing-office, with thorough knowledge of Mining, Milling and Metallurgical Plant, and with up-to-date knowledge factory methods.—Write, stating age, experience and salary required, to Box 830, Sells, Fleet-street, E.C. 4. 2926 A

ASSISTANT CIVIL ENGINEER REQUIRED by large Company for service in the East. Must have had experience of Building Construction Work in England and, if possible, with some experience in the East. Age 25/30, single. One year's agreement, extendable to three years. Free passage out and home, free furnished quarters, but without messing. Commencing salary approx. £450 p.a.—Write, giving full particulars and copies of testimonials, to Box "E," c/o The Regent Advertising Service, Ltd., 165/167, Moorgate, E.C. 2. 2908 A

PUBLIC NOTICES

Karachi Port Trust.
NOTICE.
The Trustees of the Port of Karachi invite APPLICATIONS for the POST of CHIEF ENGINEER from fully qualified Engineers not over 45 years of age, with special knowledge and experience in the construction and maintenance of harbour works.
Pay Rs. 2250 per month, rising by annual increments of Rs. 100 for approved service to a maximum of Rs. 2550. The salary is consolidated, and no allowances of any kind will be given.
The appointment is not pensionable, but the successful candidate will be required to subscribe to the Trustees' Provident Fund, in the benefits of which under their rules he will participate. Leave and leave allowances will be given under the Trustees' rules in force from time to time.
A residence will be provided, and must be occupied by the Chief Engineer on payment of rent at 10 per cent. of his pay.
Applications, with references, and copies (which will not be returned) of testimonials, and stating nationality, parentage, age, career, educational and other qualifications, and giving detailed particulars of experience, to be addressed to :
The Chairman, Karachi Port Trust :
Messrs. Rendel, Palmer and Tritton, Consulting Engineers, 12-14, Dartmouth-street, Westminster, London, S.W. 1,
so as to reach him/them on or before 31st July, 1926, the outer cover being endorsed "Appointment of Chief Engineer."
If a candidate is selected from the United Kingdom, passage by P. and O., 1st Class B, will be paid. If selected in India, he will be allowed first-class railway and steamer fares to Karachi, in accordance with the Subsidiary Rules of Government framed under Rule 44 of the Fundamental Rules.
T. S. DOWNIE, Chairman, Karachi Port Trust.
Karachi Port Trust Office,
1926. 2772

Rangoon Development Trust.
The Trust invites APPLICATIONS for the POST of EXECUTIVE CIVIL ENGINEER on a salary of Rs. 1000 per mensem, rising by annual increments of Rs. 50 per mensem to Rs. 1500, with a motor car allowance of Rs. 150 per mensem.
The engagement in the first instance will be for a period of three years, but it is possible that a permanent appointment may follow.
The applicant must be a British subject, between the age of 30 and 35 years, who has received a good general education, must have passed the examination of the Institution of Civil Engineers or of the Institution of Municipal and County Engineers, or hold equivalent professional qualifications ; must have experience in municipal civil engineering works on a large scale, including survey work, road construction, waterworks, sewage, drainage, steel work, and reinforced concrete ; this experience should include the preparation of general drawings and details, specifications and bills of quantities, estimates, and the control of such works during actual construction.
Preference will be given to a candidate with special knowledge of and practical experience in reinforced concrete, and also to approved war service.
The Engineer appointed will be provided with a free first-class passage to Rangoon and £10 for expenses on the voyage. Should he, within three months of the termination of this agreement, decide to return to this country, similar provision will be made.
Application must be made in writing, should contain the following information and copies of documents :—Full name, address, copy of birth certificate, health, married or unmarried (particulars of family) full statement in chronological order of education from the age of fourteen, training, and experience, with dates, and should be delivered not later than the 31st July, 1926, to J. LUMSDEN RAE, Esq., Reference R.2530, Dartmouth House, 2, Queen Anne's-gate, London, S.W. 1. 2855

SITUATIONS OPEN (continued)

ASSISTANT ENGINEER REQUIRED by Laundry Machinery firm ; must have good Mechanical Training ; be capable of Draughting, and have some knowledge of Electricity ; knowledge of Laundry Industry an advantage. Salary £300 p.a.—Address, 2932, The Engineer Office. 2932 A

ENERGETIC and Ambitious YOUNG ENGINEER REQUIRED to Assist in the Development and Adaptation to an old and solidly established business of a new industrial process offering excellent prospects. Generous terms to capable man able to invest up to £2000.—Address, 2934, The Engineer Office. 2934 A

ENGINEER, with Experience in Design of Mechanical Parts of Steam Locos. and preferably with practice of Electric Locos., REQUIRED.—Address, with full particulars and salary required, 2796, The Engineer Office. 2796 A

GENERAL MANAGER WANTED by Well-known Company manufacturing A.C. and D.C. Electrical Machinery (up to 1000 K.W.). Applicants must have had wide experience in works affairs, particularly on the side of business management and organisation. Ultimate directorship within reach of successful applicant. Full particulars of training, experience and age, which will be treated in strict confidence, should accompany replies.—Address, 2887, The Engineer Office. 2887 A

SITUATIONS OPEN (continued)
Page 2.

SITUATIONS WANTED, Page 2.
AGENCIES, Page 2.
PARTNERSHIPS, Page 2.
BUSINESSES and PREMISES (For Sale, etc.), Page 90.
MISCELLANEOUS, Page 2.
MACHINERY, &c., WANTED, Page 90.
AUCTIONS, Page 90.
FOR SALE, Pages 2, 3 and 90.
PATENTS, Page 2.
WORK WANTED, Page 3.

For Advertisement Rates see Page 65, Col. 1.

INDEX TO ADVERTISEMENTS
Page 89.

SITUATIONS OPEN (continued)

MECHANICAL ENGINEER REQUIRED for Small Railway in Brazil. Three years' engagement, salary £800, free quarters, free passages, good leave on full pay. Knowledge Portuguese or Spanish essential.—Write, Box 60, c/o Judd's, 47, Gresham-street, E.C. 2. 2906 A

MECHANICAL ENGINEER WANTED for Service in the East as Travelling Inspector of Rubber Plantation Machinery, &c.; must be single, not over 27; must have received public school education and good engineering training. Commencing salary £420 per annum; £50 kit allowance, first-class passage. Applicants must give full details.—Write, H. B., 64, Cannon-street, London, E.C. 4. 2930 A

PRACTICAL MAN REQUIRED for Production and Organisation of Shop manufacturing Light Ovens, Grills, Fires, &c.—State age, experience, when free, and salary required, to THE BRITISH ELECTRIC TRANSFORMER CO., Ltd., Hayes, Middx. 2888 A

RATE FIXER REQUIRED. A Thoroughly Practical man with wide experience of Modern Machine Shop practice and first-class knowledge of Speeds and Feeds for Planing, Milling, Turning, &c. State age, wage, and full details of experience. No application considered unless full particulars given. —Address, 2922, The Engineer Office. 2922 A

REQUIRED IMMEDIATELY, Experienced TRAVELLER for Steam and Water Valves. Salary and Commission.—Address, giving full particulars of experience, &c., P2098, The Engineer Office. P2098 A

SALES MANAGER REQUIRED; Good Knowledge of Precision Grinding Machines essential, in addition to thorough commercial experience.—Apply, giving full particulars of previous experience and salary required, to THE CHURCHILL MACHINE TOOL CO., Ltd., Broadheath, Manchester. 2849 A

WANTED, EXPERIENCED LOCOMOTIVE DRAUGHTSMEN for Works in Lancashire.—Address, in confidence, stating age, experience and salary required, 2927, The Engineer Office. 2927 A

WANTED IMMEDIATELY, First-class MECHANICAL DRAUGHTSMAN, with experience in Semi-automatic Machinery, not necessarily machine tools. State age, experience, and salary required.—Address, 2917, The Engineer Office. 2917 A

A DESIGNER WANTED for Motor Vehicle Works in the South of England. Must have had good experience in the design of Commercial Motor Vehicles. —Address, giving full particulars of experience, age, &c., 2890, The Engineer Office. 2890 A

CHIEF DRAUGHTSMAN REQUIRED for Structural Engineer's Office. Must be capable of taking complete control. In strict confidence.—Address, 2885, The Engineer Office. 2885 A

DRAUGHTSMEN for CRANES.—Address, stating age, experience, wages, when free, CHIEF DRAUGHTSMAN, John M. Henderson and Co., Ltd., King's Works, Aberdeen. 2929 A

DRAUGHTSMAN, with All-round Experience of the design, performance and construction of Low-level Jet Condensing Plants and Extraction Pumps, REQUIRED by an old-established firm. State full particulars of experience and salary required.—Address, 2867, The Engineer Office. 2867 A

DRAUGHTSMAN, with Experience in Lay-out of Electric Locomotives, REQUIRED. State experience and salary required.—Address, 2795, The Engineer Office. 2795 A

EXPERIENCED DRAUGHTSMAN DESIGNER for Cement and Crushing Machinery.—Apply, stating age, experience, and salary, to W. J. C., Edgar Allen and Co., Ltd., Imperial Steel Works, Sheffield. 2920 A

FIRST-CLASS ESTIMATING DRAUGHTSMAN, also good DETAIL DRAUGHTSMAN, REQUIRED, fully experienced in Telpherage and Handling Plants.—State age, experience, and salary required, to ROBERT DEMPSTER and SONS, Ltd., Rose Mount Ironworks, Elland, Yorks. 2900 A

WANTED for Large Locomotive Works in Lancashire, DRAUGHTSMEN, with previous experience on Electric Locomotive Work.—Address, 2928, The Engineer Office. 2928 A

WORKING FOREMAN BOILER SMITH, Age 30-35, REQUIRED by an Agricultural Firm. Good opening for energetic man with ideas, who wants to get on. Jacketted pans, light boilers and plate work. —Address, 2933, The Engineer Office. 2933 A

SITUATIONS WANTED

AN OPPORTUNITY.—PRODUCTION ENGINEER (34) DESIRES OPENING offering responsibility, taken control, modern works organisation, planning, tool design, shop, rate fixing, &c., high-class production.—Address, P2080, The Engineer Office. P2080 B

APPOINTMENT DESIRED by CIVIL ENGINEER, with wide experience of railway construction and management; speaks Spanish, Portuguese and Italian; age 44; highest credentials.—Address, P2095, The Engineer Office. P2095 B

BOILER ATTENDANTS, ENGINEERS, SHOWROOM HANDYMEN and CLEANERS.—For reliable time-expired Service men write:—NATIONAL ASSOCIATION FOR EMPLOYMENT OF REGULAR SAILORS, &c., (Room 6), Dock-road, Chatham. (Secretary, Commander Darwall, R.N.) Telephone, Chatham 10. All trades. No fees. P1996 B

GENERAL FOREMAN (33), with Firm of Ldn. Exors., SEEKS more advantageous POST as Works Supt., Assist. or Works Manager; thorough D.O. and shop trained; 9 yrs.' exp. as M/c shop form., fitt. and erecting form.—Address, P2097, The Engineer Office. P2097 B

MILSTRUCT E. SEEKS POSITION, where Varied experience in London and general constructional steelwork would be of value; over 20 years' experience in design and manufacture; London district preferred.—Address, P2094, The Engineer Office. P2094 B

WORKS MANAGER, ASSISTANT WORKS MANAGER, PRODUCTION MANAGER. —ADVERTISER SEEKS APPOINTMENT in any of above capacities. Age 34, 15 years' experience, general, automobile and aero. Live man with initiative and organising ability. Exceptional references.—Address, P2091, The Engineer Office. P2091 B

MECHANICAL and PETROLEUM COMMERCIAL ENGINEER REQUIRES OPENING, temporary or otherwise. Highest references. London district.—Address, P2089, The Engineer Office. P2089 B

H. & T. DANKS (NETHERTON) Ltd
NETHERTON DUDLEY.

BOILERS BRICK SETTINGS, CHIMNEYS, BUILDINGS.

TANKS STEEL CHIMNEYS. SEE LAST WEEK'S ADVT.

SITUATIONS WANTED (continued)

DRAUGHTSMAN, Mechanical (30), SEEKS ENGAGEMENT. Long and varied experience in general engineering and design of intricate mechanisms. London district preferred, but not essential.—Address, P2092, The Engineer Office. P2092 B

DRAUGHTSMAN (34), Works and Technical Training, 14 years' up-to-date D.O. experience in high and low-pressure air compressor and steam engine design, used to working without supervision, SEEKS POSITION in Drawing-office.—Address, P2090, The Engineer Office. P2090 B

PARTNERSHIPS

IF YOU ARE SEEKING

A PARTNER or PARTNERSHIP

or wish to buy or sell a

BUSINESS or WORKS

Write:

WHEATLEY KIRK, PRICE & CO.,

46, Watling Street,

London, E.C. 4.

Established over 75 years.

PUBLIC WORKS CONTRACTORS, Well-known firm, REQUIRE ADDITIONAL CAPITAL. Responsible position or directorship can be arranged.—Address, 2897, The Engineer Office. 2897 C

EDUCATIONAL

A CHARTERED CIVIL ENGINEER, Long Established, will shortly have VACANCY for well-educated YOUNG GENTLEMAN as PUPIL. Premium required.—Address, 2831, The Engineer Office. 2831 B

COACHING for INST. C.E. EXAMINATION, Personal or by correspondence.—To G. W. M. BOYCOTT, Assoc. M. Inst. C.E., Chandos House Palmerstreet, Westminster, S.W. 1. 2808 B

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter. B.Sc.), and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours). Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams., comprising hundreds of successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E., &c., 8/11, TRAFFORD CHAMBERS, 58, SOUTH JOHN-STREET, LIVERPOOL. Telephone No. 1118 Bank Ex. E.

AGENCIES

WANTED, AGENTS for Our First-class Progressive Surveying Instruments. Highest references of important British customers.—H. WILD, Ltd., Heerbrugg, Switzerland. 2914 D

AGENCY WANTED by Engineer Residing Manchester in touch for selling Steel Reinforcement Fabric for Roads, Concrete Structures, &c.—Address P2083, The Engineer Office. P2083 D

EXPORT to RUSSIA.—ENGINEER, Just Returned from Soviet Russia after 6 years' work in equipping industries, speaking language fluently and having connections, DESIRES to ACT, either in Russia or here, as REPRESENTATIVE for British Firms.—Write, Box 801, Sells, Fleet-street, E.C. 4. 2896 D

MISCELLANEOUS

AMBITIOUS MEN Should Apply at Once for Free Booklet giving full information regarding the A.M.I. Mech. E., A.M.I.E.E., A.M.I.A.E., and all other Technical Examinations. Tuition guaranteed until successful. Lowest fees. Courses in all engineering subjects leading up to the A.M. Tech. I. qualification.—Write at once, stating branch of engineering in which you want to specialise, to the TECHNOLOGICAL INSTITUTE, 70, Thanet House, 231, Strand, W.C. 2. P2073 I

SPECIFICATIONS PREPARED for Purchase of Mechanical and Electrical Equipment. Equipment inspected and tested at makers' works.—Write, BM/BA49, London, W.C. 1. P2047 I

WASHED MUTTON CLOTH WIPERS. Guaranteed sterilised. Stocks held in London for immediate delivery. Goods packed for export. Trade supplied for re-sale.—Inquiries, 123, Latimer road, W. 11. Park 4850. P2096 I

PATENTS

IT is DESIRED to SECURE the Full COMMERCIAL DEVELOPMENT in the United Kingdom of BRITISH PATENT No. 139,552, which relates to "Apparatus for Cutting Metals Under Water," either by way of SALE or the GRANT of LICENCES on reasonable terms. — For particulars apply, PHILLIPS'S, 70, Chancery-lane, London, W.C. 2. 2924 H

KING'S PATENT AGENCY, Ltd. (Director, B. T. KING, C.I.M.E., Registered Patent Agent, G.B., U.S., and Canada). Inventions advice handbook and consultations free.—146a, Queen Victoria-street London, E.C. 4. 40 years' refs. 'Phone: Central 682 2754 H

THE OWNERS of BRITISH PATENTS No. 130,577, entitled "Improvements in or relating to Packet Making and Charging Machines for Packing Matches, Cigarettes and the like" No. 153,158, entitled "Improvements in or relating to Feed Devices for Veneer Cutting Machines, Lathes, Milling Machines, and the like;" No. 171,436, entitled "Improvements in or relating to Packeting Devices for Boxes and the like containing Cigarettes or Similar Articles;" and No. 184,647, entitled "Improvements in or relating to Machines for Manufacturing Packets for Packing Cigarettes or the like" DESIRE to DISPOSE of the same or would ENTER into WORKING ARRANGEMENTS with a firm likely to be interested. —Particulars may be obtained from TECHNICAL RECORDS, Limited, of 59-60, Lincoln's Inn-fields, London, W.C. 2. 2905 H

THE PROPRIETOR of BRITISH PATENT No. 161,489, dated July 29, 1920, relating to "Improvements in Oil Pumps for Lubricating Purposes," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 2839 H

THE PROPRIETOR of BRITISH PATENT No. 150,507, dated July 29, 1919, pertaining to "Improvements relating to Apparatus for Measuring Off Lengths of Cloth and other Fabrics," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Illinois. 2838 H

THE PROPRIETOR of BRITISH PATENTS Nos. 140,417, dated August 7, 1918, relating to "Trailer Truck for Locomotives;" and 188,077, dated August 3, 1921, relating to "Improvements in or relating to Railway Vehicles," is DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCES or otherwise on reasonable terms for the purpose of EXPLOITING the above patents and ensuring their practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Illinois. 2837 H

THE PROPRIETOR of BRITISH PATENT No. 147,731, relating to "Water-tube Boilers," is DESIROUS of ENTERING into NEGOTIATIONS with British manufacturers with regard to the SALE of the above PATENT or the GRANTING of LICENCES thereunder.

For further particulars apply, H. N. and W. S. SKERRETT, 24, Temple-row, Birmingham. 2894 H

THE PROPRIETOR of BRITISH PATENT No. 203,179, dated August 28, 1922, relating to "Improvements in Stookers," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, 28, East Jackson Blvd., Chicago, Illinois. 2886 H

THE PROPRIETORS of BRITISH PATENT No. 182,455, for "Weighing Machine with Automatic Indicating or Printing Device," DESIRE to SELL the PATENT, to GRANT Manufacturing LICENCES, or to make other arrangements on reasonable terms for the purpose of working the invention in this country.—For full particulars apply, MATHYS and SQUIRE, 52, Chancery-lane, W.C. 2. P2088 H

THE PROPRIETOR of BRITISH PATENT No. 187,671, dated July 14, 1921, relating to "Improvements in Fluid Pressure Engines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 2895 H

FOR SALE, THEODOLITES, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 338, High Holborn, W.C. (Opposite Gray's Inn-road).

FOR SALE, LEVELS, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 338, High Holborn, W.C. (Opposite Gray's Inn-road). Ex

FOR SALE

NEW & SECOND-HAND

RAILS AND SLEEPERS

R. H. NEAL & Co. Ltd. PLANT HOUSE, EALING, LONDON, W.5

FOR SALE.

THREE 5-TON ELECTRIC GANTRY CRANES,

by Holt and Willetts. Spans 21ft. 3in. and 23ft. 10in. Motors by Vickers for 250 volts D.C

Full specification and price on request,

HUGHES, BOLCKOW & CO., LTD., THE AERODROME, MARSKE-BY-THE SEA, YORKS.

STEEL RAILS.

All Sections.

(British Steel and Manufacture).

POINTS & CROSSINGS, CHAIRS, etc.

EDWARD SISTERSON, LTD.

St. Nicholas Chambers, NEWCASTLE-ON-TYNE.

BABCOCK and WILCOX 1918 WATER-TUBE BOILER, 42 tubes, 160 lb. w.p., drum 22ft. by 3ft.

TWO ROBEY LOCO. TYPE BOILERS, 1560 lb. evaporation each, new 1918, 120 lb. w.p.

HARRY H. GARDAM and CO., Limited, Staines. 'Phone 98. 2719 G

CORNISH BOILER, by Marshall, 20ft. Long by 6ft. dia., 100 lb. w.p.

TWO VERTICAL STEAM ENGINES, by Marshall, "MP" Type, cyl. 12in. dia. by 16in. stroke.

HARRY H. GARDAM and CO., Limited, Staines. 'Phone 98. 2809 G

ENGLISH MILD STEEL BARS, 2in. to 7in. Dia; £2 black, £7 per ton; bright, £9 per ton, F.O.R. London.

Apply, C. A. ROBINSON and CO., Dept. P.H.C., Anchor Wharf, East Greenwich, S.E. 10. P2093 G

ENQUIRIES INVITED

FOR LARGE STOCK OF MACHINERY AND PLANT Available for Immediate Disposal.

Overseas orders packed and delivered. F.O.B. Glasgow Docks.

JOHN McILWAINE, Engineer, 316, Petershill-road, Springburn, Glasgow.

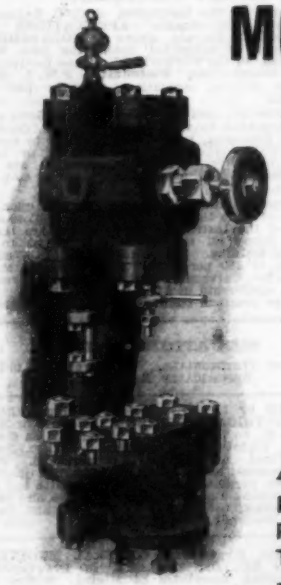
FOR SALE.

40-TON ALL-STEEL ELECTRIC DERRICK CRANE (Butters),

45ft. jib, 440 volts. Cheap for prompt clearance.

THOS. W. WARD, LIMITED, Albion Works, Sheffield. 2921 G

For continuation of For Sale Advertisements see page 3.



MOORLANDS PUMPS

FOR

LAND & MARINE REQUIREMENTS

PUMPS UP TO ANY CAPACITY FOR

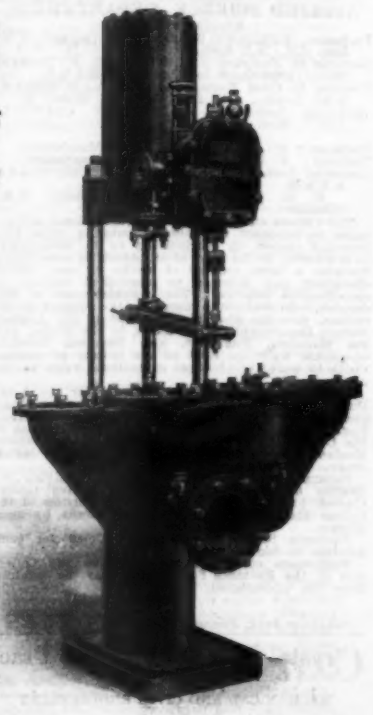
BOILER FEED
GENERAL SERVICE
BILGE
BALLAST
BRINE
ACIDS, ETC.

Also Manufacturers of:

PATENT "VISCOS" STEAM PUMPS for HEAVY FUEL OILS, TAR, SYRUPS, Etc.

DUPLEX STEAM PUMPS.

ELECTRIC PUMPS for any duty.



THE MOORLANDS ENGINEERING Co. LTD.

LEEK, STAFFS. ENGLAND.

LONDON AGENTS: Messrs. E. Alexander & Co., 32, Victoria Street, London, S.W. 1.

A Seven-Day Journal

U.S. Naval Magazine Explosion.

THE principal ammunition magazine of the United States Navy, situated at Lake Denmark, New Jersey, was completely destroyed on Saturday last, July 10th, by a series of explosions, caused in the first instance by lightning striking a building in which high explosives were stored. Of the Marine detachment on guard at the magazine, more than fifty are missing, and it is feared that the list of casualties will be a heavy one. So powerful were the detonations that neighbouring towns were wrecked, and magazines also expoded at an Army arsenal more than 2 miles from Lake Denmark. Although the Lake Denmark establishment had been in existence for many years, it was thoroughly modern in equipment, and as recently as 1918 the fire and lightning protection system had been renovated at heavy expense. The average quantity of naval powder and projectiles handled at Lake Denmark each year was 50,000 tons. It was the largest plant in the country for powder drying and shell filling, and the stocks of explosives in hand were always very considerable. During the war it was used as a storage centre for naval mines and torpedo warheads. Fortunately, the explosion did not occur until the late afternoon, when all the civilian employees had left, but two-thirds of the official staff are believed to have perished. There are three other large naval ammunition depôts in the United States, situated respectively in New York, Virginia, and Pennsylvania.

Disposal of Surplus Warships.

TWENTY vessels are to be removed from the effective list of the Royal Navy during this financial year, according to an Admiralty statement in Parliament. They include four battleships, viz., King George V., Ajax, Thunderer, and Agamemnon. The first three have been condemned under the provisions of the Washington Treaty, which requires that they shall be scrapped upon completion of the battleships Nelson and Rodney. The King George V. and Ajax are sister ships, launched in 1911–12, and together with the other two units of the class, Audacious and Centurion, formed one of the most powerful divisions of the Grand Fleet. The Audacious, it will be recalled, was sunk by a mine early in the war. The Centurion is to be retained in the Fleet as a non-combatant vessel, and will in future serve as a target ship in place of the Agamemnon, which has performed this duty for five years. The Thunderer was launched in 1911. The fifteen destroyers to be disposed of are the Radstock, Rapid, Raider, Retriever, Redgauntlet, Satyr, Sorceress, Sabrina, Sharpshooter, Stork, Sable, Sikh, Truculent, Tarpon, and Telemachus. All belong to the Admiralty, Thornycroft and Yarrow, "R" and "S" classes, laid down under the war programmes of 1915–17. Some of these boats have not yet been eight years in service. With the exception of two Thornycroft boats, which had a contract speed of 35 knots, all were designed for 36 knots, a speed which was generally attained on trial. The list is completed by submarine L 9, completed as recently as 1918. It is further stated that the Canadian Government proposes to sell the cruiser Aurora and submarines CH 14 and CH 15. When these vessels have gone, the only craft of any military value remaining in the Royal Canadian Navy will be two destroyers.

Waterworks Extensions at Plymouth.

THE members of the Plymouth Corporation once more observed last week the time-honoured ceremony, now 300 years old, of repairing to the waterworks on Dartmoor, which were first established by Sir Francis Drake, in order to raise goblets of pure water to his pious memory, and to express with quaffs of wine their hope that the descendants of him who brought them water would never want wine. Occasion was taken of the visit to inspect the great extension which is being carried out at the Burrator Reservoir, under the superintendence of the water engineer, Mr. Frank Howarth. When these works, which have necessitated the raising of the great dam and the submersion of certain roads, are completed, the Burrator Reservoir will have a surface area of 140 acres, a capacity of 1025 million gallons, and will, it is anticipated, provide sufficient water to meet the requirements of Plymouth's population for a period of thirty years to come. Some 200 men have been employed on the work for the past two and a-half years. The undertaking now carries water by 240 miles of steel pipes to the doors of 220,000 consumers, who use on an average for all purposes, including trade, domestic and sanitation, 50 gallons per head per day. When the work is completed, the undertaking will have involved a capital expenditure of considerably over one million pounds, and it will be capable of supplying the needs of half a million people, a population to which Plymouth is not expected to attain for at least another thirty years. It is interesting to contrast the present waterworks with the scheme for which Sir Francis Drake, when Mayor of Plymouth, was responsible. His work for conducting water from Dartmoor to Plymouth by means of an open leat a few feet wide, constructed of granite, which still exists as an object of interest to visitors, was at the time considered an engineering feat of no small magnitude. The leat runs a distance of something like 20 miles, and it is related that when the first flow of the stream through it passed his own door, Sir Francis, "in exultation that he had obtained his desired end," dipped his scarlet cloak therein.

Coal.

ON the afternoon of Thursday, July 8th, Mr. Frank Hodges delivered a lecture on the Economics of the Coal Question at the Royal Society of Arts, before a large audience He showed by a few striking figures the relative position of the coal trade of Great Britain and of other European countries, dwelt upon the absolute necessity that this country should have a large foreign market, and touched upon the decreasing output per man per shift. "Seven men now," as he put it, "desire to live on what six lived on before, and to live better." He spoke strongly on the folly of the strike, and said he had done his best to show the unions that by making the economic position worse than ever they could do themselves nothing but harm. He regretted that they had not frankly accepted the report of the Royal Commission. He spoke with much energy on what science could do for coal, and declared that we were on the eve of a development which would give us all the oil we required by the distillation of coal, and leave us with a valuable fuel. Finally, he came to the consideration of the crisis. He was strongly opposed to any reduction of wages, because he was convinced that any changes here would have their repercussion in other countries where the miners are already grievously underpaid. Neither did he like the idea of lengthening the hours, though he accepted it as a temporary necessity. He hoped that when the Eight Hours in Mines Bill became an Act colliery owners would only work forty-eight hours per week when it was absolutely necessary. They ought not to seek to make dividends, but should set about the improvement of the mechanical equipment and reorganisation of mines. He failed to see why the Government should not advance thirty or forty million pounds for five years to put the mines on a sound scientific and economic basis.

Wireless Exhibitions.

SOME particulars of the forthcoming autumn wireless exhibitions have just been issued. For the first time, the National Radio Exhibition in London will run concurrently with the Grosse Deutsche Funk Austellung, the German wireless exhibition in Berlin, thus eliminating the advantage which the latter had last year of being the first in the field. As the London Exhibition will extend from September 4th to 18th, and the Berlin Show only from September 3rd to 12th, it will still be possible for the keen wireless enthusiast or trader to ascertain by actual inspection of the show models exactly what advances have been made in this rapidly changing industry, and to compare the relative progress of the two countries. This year the size of the two Exhibitions will be more equally balanced. For the past two years the Berlin Show has been the most extensive, for the number of exhibitors exceeded 200 on both occasions, as compared with 60 and 67 at the two main British Exhibitions. In the past an appeal has been made in this country to only one section of the trade, but this year the Exhibition will be open to a wider field of manufacturers, and more than 130 exhibitors have already taken space.

The Construction of Danger Buildings.

IN the fiftieth annual report, issued this week, of his Majesty's Inspectors of Explosives, a point regarding the design of danger buildings is raised which may well have the attention of engineers. The ideal roof for a danger building, the inspectors state, has probably not yet been found. It should be of such construction that it will resist heavy *débris* falling on it, while not itself providing heavy *débris* in the event of an explosion occurring beneath it. An explosion which occurred during the year at Curtis and Harvey's factory at Faversham is used to illustrate the point. A new press house blew up and heavy *débris* fell through the roof of an old press house, 100 yards distant, and caused a charge of 10 cwt. to explode and wreck the building. The old house had a thick slate roof, with plain glass skylights. Another item connected with the design of danger buildings to which the inspectors call renewed attention is the construction of the floors. Asphalt floors, if finished with a smooth, hard gritless surface, appear to be very satisfactory, but the evidence submitted in connection with the Faversham accident would suggest that scrupulous care is required on the part of the contractors to ensure that no particle of flint or other grit likely to cause a spark when a heavy article is moved across the floor is introduced into the asphalt. Asphalt has the great advantage that it can be laid on a solid foundation, and can be curved into the walls to facilitate washing and sweeping. In contrast with an asphalt floor, the inspectors refer to a press house sixty years old, which was recently dismantled. It was provided with a wooden floor, and when the floor was taken up after the building had been thoroughly washed out, no less than 16 cwt. of gunpowder dust was found.

Sir W. G. Armstrong, Whitworth & Co., Ltd.

SOME important additions to the board of directors of Sir W. G. Armstrong, Whitworth and Co., Ltd., are announced. Three new directors have been appointed, including Mr. J. D. Siddeley, the managing director of Armstrong-Siddeley Motors, Ltd.; Mr. James Hawson, of Edinburgh, late vice-president and director of the Algoma Steel Corporation; and Mr. J. P. Davison, the general sales manager of Sir W. G. Armstrong, Whitworth and Co., Ltd. At the same time certain changes in the management of the company have been made. Mr. J. Frater Taylor has been appointed vice-chairman of the board and chairman of the executive committee; while Mr. J. D. Siddeley becomes the senior managing director and chairman of the committee of management, giving his special attention to the manufacturing side of the company's business. With the changes indicated, the board for the most part will now consist of active directors. The shipbuilding branch of the business is in future to be self-contained, and for this purpose a management corporation has been formed, of which Sir Eustace Tennyson d'Eyncourt, late Director of Naval Construction, is chairman, and Mr. James Stewart the managing director.

A New Type of Oil Tanker.

THE oil tanker the British Inventor, which was built by Palmer's Shipbuilding and Iron Company, Ltd., of Jarrow-on-Tyne, and which after undergoing successful trials at the end of last week was handed over to the British Tanker Company, Ltd., of London, is the first vessel to be constructed on the Isherwood bracketless system. She has a length of 447ft., with a beam of 57ft. 8in., and is designed to carry about 10,650 tons deadweight, on a moderate draught. The machinery installation, which is fitted aft, comprises a single set of triple-expansion engines, designed to give the vessel a speed of 11 knots. Steam is raised in three cylindrical boilers fitted with Howden's forced draught and arranged for oil burning. The interest in this vessel lies with the bracketless system of ship construction, recently introduced by Sir Joseph W. Isherwood. In it the large flanged brackets at the bulkheads, which are associated with the usual longitudinal Isherwood framing, are entirely avoided by a rearrangement of the structural members of the hull. The ends of the longitudinals for the decks, sides and bottom are simply snipped off, resulting in a very considerable simplification of the plating and riveting work throughout the ship. During the trials, although the vessel was run at a speed of 11½ knots, there was, we learn, a marked absence of vibration, while the deflection tests which were made by Sir Joseph Isherwood at Jarrow proved entirely satisfactory. Some motor tankers of this new type are to be built both in America and Norway.

Extensions at the Barking Power Station.

APPARENTLY the Barking power station is to be considerably extended. Full details are not yet available, but a contract is reported to have been placed with the International Combustion Company, Ltd., for new steam generating plant representing an output of 100,000 kilowatts. The existing boilers are fitted with mechanical stokers of the travelling grate type, but the new boilers are to be fired with pulverised coal. The new steam-raising plant, which will presumably be installed in the second section of the station, will include ten Babcock and Wilcox boilers, with superheaters and economisers, air heaters and Lopulco pulverised coal equipment. The installation will also include five steel chimneys, one for each pair of boilers, a collection of boiler-house control instruments, boiler feed pumps, and thirty electrically driven fans.

The Status of Naval Engineer Officers.

IN the House of Lords on Wednesday afternoon the question of the advisability of the Fleet Order of November last was raised by the Duke of Northumberland in a motion for papers. He said that the order abolished the last vestige of the improved status of the engineer officer under the 1902 scheme and relegated the officer to the non-executive branch. The Duke of Montrose, whilst supporting the Admiralty, thought it would be "a graceful gesture" to appoint a naval engineer as a Sea Lord at the Admiralty, and to give naval engineer officer executive command in certain naval establishments ashore. Lord Chelmsford said he felt it was most necessary not to arouse any new feeling of grievance and supported the Duke of Northumberland. Lord Selborne said that by the unfortunate order of last year an old sore had been re-opened'; that order might do great harm, and could do no possible good. Earl Stanhope, Civil Lord of the Admiralty, replied. He insisted that there had been much misunderstanding about the order. It did not affect the rank, title or powers of engineer officers and did little more than regularise the situation already existing. There was no intention to put the smallest slight on the engineer branch of the service. The motion was withdrawn.

The Moffat Railway Tunnel, U.S.A.

No. III.*

Tunnelling in Bad Material.

The description of tunnelling methods given in the previous article relates only to that part of the work in solid rock, as encountered in the east workings. Under the bad conditions of driving through the shattered rock and unstable ground at the west end very different methods were employed. Drilling the blast holes in the headings was done largely with compressed air drills mounted on bars wedged into place, instead of using a travelling drill carriage. These bars were set in place as soon as the top of the muck or spoil had been cleared sufficiently to make room for the drills at the face of the heading. In part of the work only one hole at a time was fired, and even then slips occurred or large pieces of rock would fall and damage the timbering. The spoil was loaded into cars by hand, as the conditions did not permit the use of mucking or loading machines. In very bad cases the soft rock was excavated only by picks, without blasting.

Reference has been made already to the very heavy timbering employed in such ground, with timbers 12in. by 18in. in section, sets practically in contact, and even double sets. In April, 1926, a collapse of the west heading in the pioneer tunnel was prevented only by prompt measures for reinforcement. At about 12,300ft. from the portal, 12in. logs of Oregon fir across the roof bent downward until they began to crack on the underside, while similar posts, 12in. by 12in., in the south wall were bent into bows by the excessive pressure. New sets with heavier timbers were placed for a distance of about 30ft.

Tunnel Enlargement.

To facilitate the enlarging of the main heading to full section for the railway tunnel this heading was driven mainly at the top of the tunnel section, instead of in the middle, as in the solid rock at the east end. The first step of the enlargement was the widening of this top heading, after which the lower part or bench was excavated in one or two stages, according to conditions. In this widened heading it was necessary to use five-segment roof arches, shown already in Fig. 10 *ante*. A stretch of this heading, with timber wall plates instead of the rolled steel joists afterwards used, is illustrated in the upper view on page 64. Here the wall plates are mounted on short side posts. In this work the first operation was to place the crown timber of the roof arch, and then to widen the sides of the heading successively for the upper segments, and, finally, for the lower segments and a temporary wall plate. The permanent wall plate was installed as soon as there was a sufficient length of roof supported by the timbering. Then a section of bench was taken out and the wall plates supported on short posts, as seen in the illustration.

This tunnel enlargement in bad ground was much slower than the similar work in hard rock, and could not keep pace with the advance of the headings. To meet this condition the pioneer tunnel proved of great advantage, by enabling the enlargement to be carried on from interior headings, as well as from the portal. The excavated material from the interior workings was brought out through the cross-cuts and thus through the pioneer tunnel.

Bottom Side Heading Method.

In enlarging the tunnel heading from the west portal a different method was used, as the ground was fairly stable for some distance. This method is illustrated in Fig. 14. Here, a bottom heading A, 10ft. wide and 11ft. high, was first driven along one side of the tunnel section. Holes were then drilled in the wall and the heading widened 6ft. to full section at B. The roof of the heading was then drilled with stoping drills to blow down about 7ft. of roof at C, and finally holes were drilled to finish the arch D.

The areas of these successive sections to neat lines were 110 square feet for heading A, 66 square feet for widening B, 111.6 square feet for roof lift C, and 68.9 square feet for finishing the arch D. It is estimated that the cost of this method was £14 per lineal foot of finished tunnel, as compared with £16 for the centre heading and enlargement, as already described for good rock and shown in Fig. 11 *ante*.

Special Roof-supporting Devices.

To hold the roof timbering securely in bad ground while taking out the bench sufficiently to allow of placing side posts under the wall plates as laid on the floor of the heading, special devices were introduced. The first of these was a needle-bar composed of a pair of 24in. rolled steel joists, 20ft. long and 5ft. apart, supported at each end by a transverse 15in. joist seated on the wall plates. It will be seen from Fig. 15 that the needle bar extended over the bench, its rear end being in the enlarged tunnel and its forward end in the heading. It was secured in place by 12in. by 12in. timbers laid across its ends and wedged against the roof timbering.

From the middle portion of the needle bar were hung suspenders, each consisting of four 1¼in. threaded rods, the upper ends of which passed through plates laid across the 24in. joists. The lower ends of these rods carried plates, 6in. by 18in. and 2in. thick, upon which were seated transverse 12in. joists long enough to fit under the wall plate timbers. With these 12in. joists in place the nuts of the hanger rods were screwed up until the joists took a bearing against the wall plates, which were thus carried over the bench by the needle bar instead of being supported on the floor of the heading. Then the bench could be excavated under the roof timbering until the tunnel section was enlarged sufficiently to allow of setting side posts under the wall plates, as at the left in Fig. 15. With these posts in place the needle beam was released and shifted ahead.

In the lower illustration on page 64, looking back from the heading, the ends of the 24in. steel joists are shown resting on the transverse 15in. joist, while below are suspended the 12in. joists, the ends of which carry the wall plates and roof timbering. On each side are some of the temporary short posts seated on the bench, and beyond is the regular tunnel timbering.

Cantilever Support for Roof.

Where the rock pressure was severe the needle beam device could not be used, as the wall plates would be bent or shifted inward by the movement of the ground, causing distortion of the roof arch. To meet this condition a travelling cantilever girder was devised by Mr. George Lewis, general manager of the Tunnel Commission, and in direct charge of the work. No side support was needed for the cantilever as for the needle beams, but, on the other hand, it provided both bottom and lateral support for the timber wall plates.

This cantilever—as shown in Figs. 16 and 17—consists of a pair of 60ft. plate girders, 4ft. deep and 6ft. apart, connected by transverse struts and diagonal bracing. Its fulcrum point, near the rear of the heading, rests on groups of rollers riding in rolled steel joists or laid flat on a pair of longitudinal timbers along the floor of the heading, or in some cases the rollers rest on four or five light steel rails, laid side by side. The cantilever end of the girder projects 15ft. to 20ft. from the heading, over the length of bench to be taken out, while its further end—within the heading—is anchored by blocking jacked and wedged between the girder and the arch timbering.

Transverse steel joists are hung below the cantilever, being carried in cross frames or suspenders which straddle the top booms of the two girders. These joists are telescopic, for adjustment, and fit between the wall plate timbers so as to form transverse braces. At the ends of these joists are hook-shaped stirrups which fit under the wall plates and form their support. When thus adjusted in position the stirrups are drawn up by a wedge device operated by a right and left-hand screw, until the load of the roof arch is taken off the side posts and carried entirely by the cantilever girder.

This device has carried the roof arch while a length of 10ft. to 20ft. of bench has been drilled, blasted and cleared, and full height side posts placed. As each length of bench is completed and timbered, the jacks and blocking at the rear of the girder are released, the transverse joists are drawn inward clear of the wall plate, and the girder then hauls itself forward by a motor winch and cable.

A novel arrangement of side timbering was devised

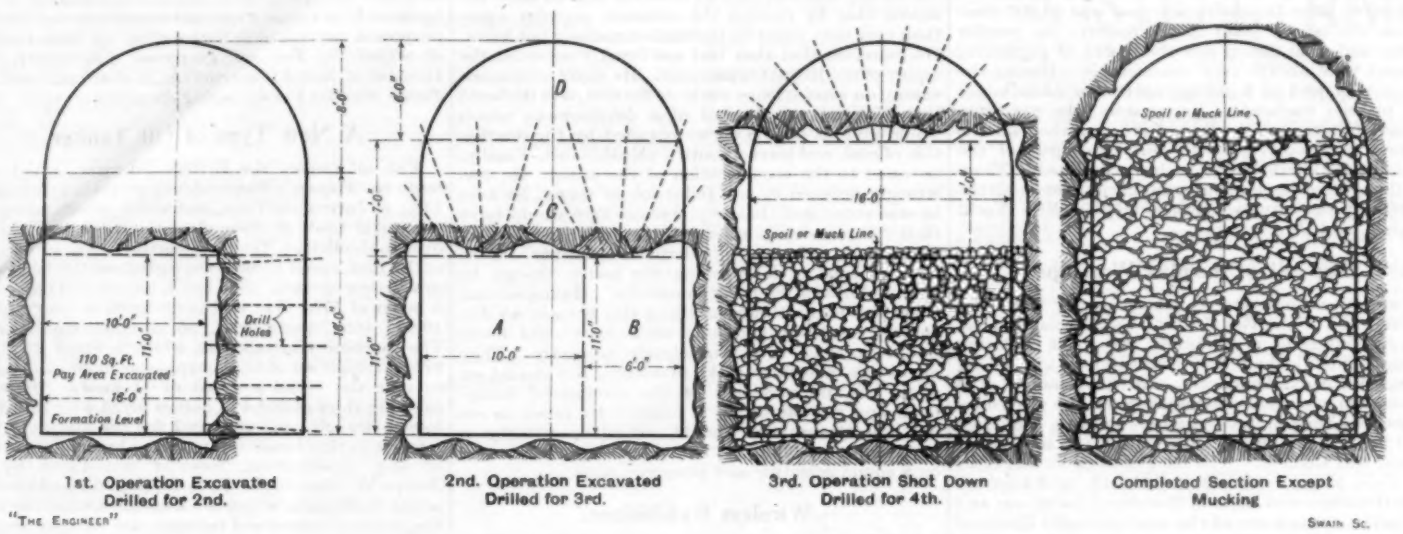


FIG. 14—ENLARGING TUNNEL HEADING IN FAIRLY STABLE GROUND

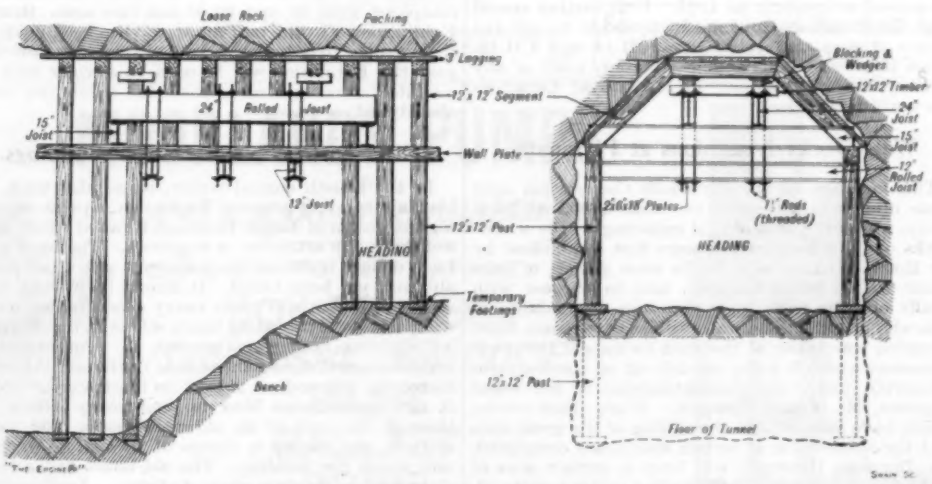


FIG. 15—METHOD OF SECURING ROOF TIMBERING IN BAD GROUND

* No. II. appeared July 9th.

for the bench when the pressure was so great as to bend the ordinary 12in. by 12in. side posts, which were 19ft. high. As the bench was excavated for the first lift or stage of about 10ft., alternate vertical and raking posts of this height and spaced 24in. on centres, were fitted under the wall plates and seated on 6in. by 12in. sills laid flat on the bench, the sill for the raking posts being just behind that for the vertical posts. When the second lift of the bench was taken out to formation level, inclined or raking posts were set under the rear sill, inclined inwards, and thus forming a two-segment vertical arch. The intermediate short vertical posts were removed and side posts of full height were set in their place, under the wall plates, thus alternating with the two-segment side arches. Even this was insufficient in places, and double timbering sets had to be substituted.

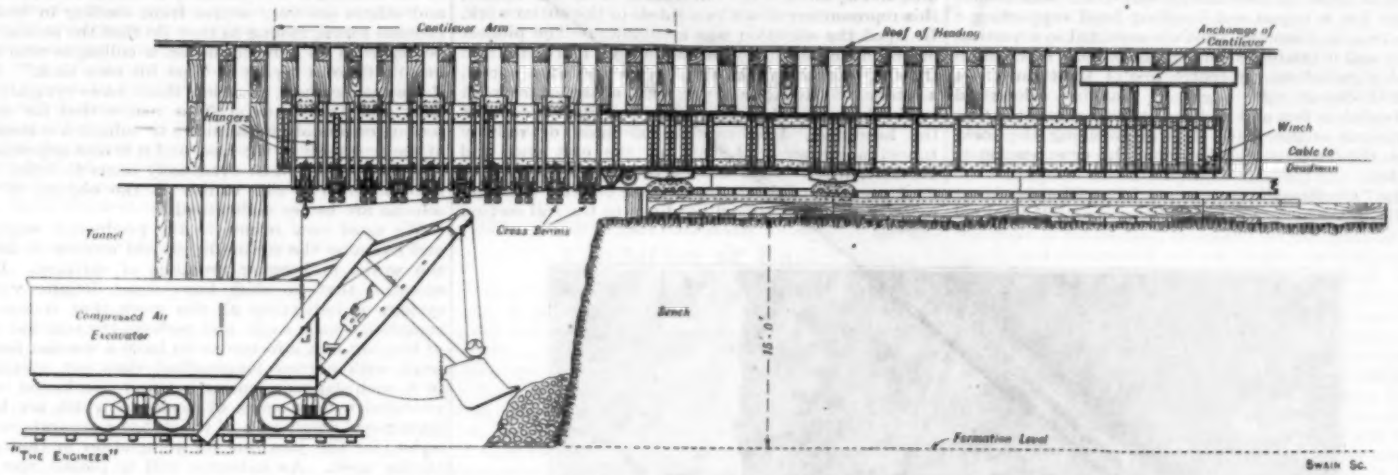


FIG. 16—CANTILEVER SUPPORT FOR ROOF WHERE ROCK PRESSURE WAS SEVERE

Electric Supply, Haulage and Ventilation.

A supply of electric current at 44,000 volts is brought by a transmission line from a commercial hydro-electric central station to a substation near one end of the tunnel. There the current is stepped down to 2200 volts to operate the motors for the air compressors, ventilating apparatus, pumps and other machinery. Lower voltages are used for the locomotives and for lighting, blasting, and miscellaneous purposes. A power line and a telephone line are carried over the mountain to connect the two camps and tunnel power stations.

At the power house at the east portal—shown in Fig. 18—there are four air compressors, 14in. by 20in. each, with a capacity of about 1200 cubic feet of free air per minute, delivered at 100 lb. pressure. All of these are belt driven by synchronous motors of 200 horse-power. There is also a 100 horse-power motor generator set taking current from the 2200-volt line and supplying 250-volt direct current for operating the trolley locomotives, the loading machines and other machinery. Similar motor-generator units are also installed in chambers in the tunnel. At the west portal there are five air compressors with a total capacity of about 4000 cubic feet per minute. Two of these are rated at 500 cubic feet capacity each, and are driven by 75 horse-power synchronous motors. All these capacities are rated for the high altitudes of the power plants. There is also a motor generator set similar to that at the east end.

The small tunnel cars of 24in. gauge, as used in the headings, are taken by storage battery locomotives from the face to a point about 200ft. to 400ft. back, in the pioneer tunnel, at which point the overhead equipment for the trolley locomotives is stopped in order to be out of the reach of possible damage by the blasting. Thence 12-car trains are taken by

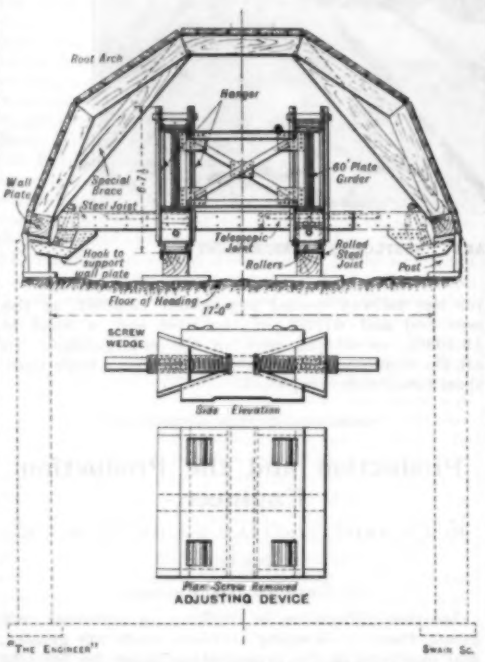


FIG. 17—CANTILEVER SUPPORT FOR ROOF

250-volt trolley locomotives to a siding outside the portal, where the cars are side-tipped to discharge their contents into cars of 4 cubic yard capacity standing on a line of 36in. gauge at a lower level. The 4-yard cars used in hauling spoil from the enlargement of the main tunnel in the portal workings are brought out at the same point. Trains of these 4-yard cars are taken by larger electric trolley locomotives to be tipped for filling purposes.

In February, 1926, there were eighteen of the cross-cuts or drifts connecting the pioneer tunnel with the workings on the main tunnel. Ten of these drifts were at the east end, where progress has been the more rapid. When the movements of spoil trains in the pioneer tunnel becomes congested, sidings for empty cars are laid near the last cross cut and a chamber is excavated for a motor generator set, which converts the 2200-volt alternating current to 250-volt direct-current for the operation of the trolley locomotives and the mucking or spoil loading machine.

For the main ventilating system there are at each end of the pioneer tunnel two blowers driven by 100 horse-power electric motors and having a combined capacity of 8000 cubic feet of free air per minute at 4 lb. pressure. The air is delivered through 12in. sheet iron pipes having telescopic or slip joints, which are drawn tight by bands to prevent leakage. For each heading of the main tunnel there are two ventilating fans placed in the pioneer tunnel just back of the cross cut nearest to the full size enlargement. Each fan is driven by a 10 horse-power motor and delivers 12,000 cubic feet per minute at $\frac{1}{2}$ oz. pressure, discharging the air through a bulkhead to force the smoke and gases from the heading into the cross cut and pioneer tunnel, whence they escape through the portal end of the enlarged main tunnel. In Fig. 19 is shown one of these ventilating chambers, with two blowers, beyond which is the fan. At the right is the 24in. tunnel track with electric locomotive.

The pioneer tunnel is closed off from the cross cuts for ventilation purposes by means of bulkheads fitted with double swinging doors. These doors are held normally closed by counterweights, but they do not require attendants, as they are equipped with buffers or bumpers so that they are struck and opened by the tunnel trains.

High-pressure air for the drills is carried through the tunnel by 7$\frac{1}{2}$in. wrought iron pipe.

Surveys and Cross-sectioning.

Triangulation surveys and a centre line survey have been carried across the range, with backsights established at points distant from the portals. From these backsights the lines and levels are carried into the

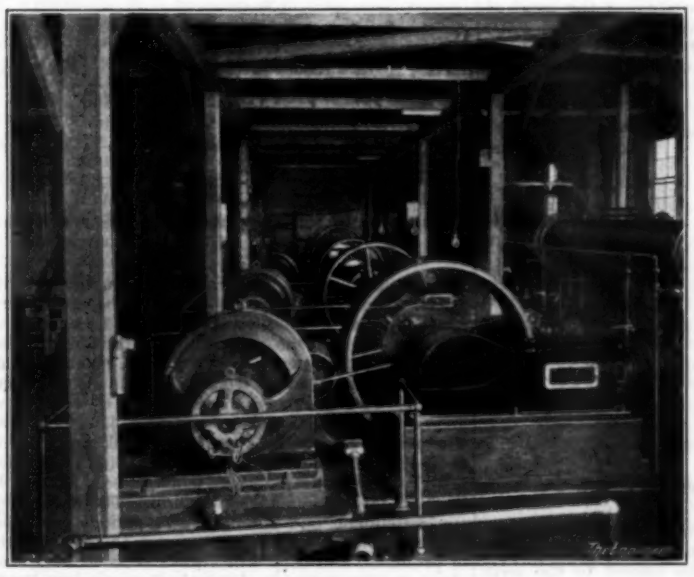


FIG. 18—POWER-HOUSE AT EAST PORTAL

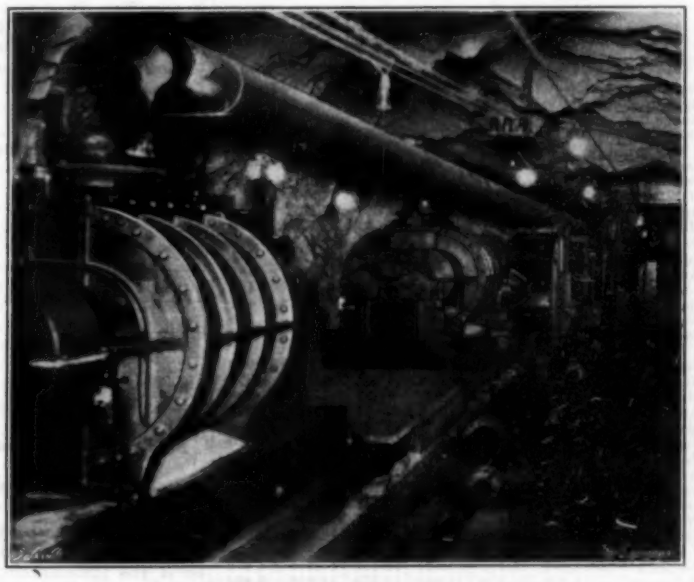


FIG. 19—BLOWERS AND FAN IN TUNNEL

tunnel. For determining the actual excavated cross section in rock, to be compared with the neat lines upon which quantities for payment are based, there is used an instrument called a "sunflower," which has a tripod and levelling head supporting a disc 18in. in diameter, which is mounted in a vertical plane and is graduated in degrees. With this instrument adjusted on the centre line of the tunnel, and with its disc at right angles to that line, a long rod graduated in feet and inches is placed across the disc at various angles, with its end touching the rock. From these angles and distances the cross-section is plotted.

The "sunflower" instrument in position is shown in Fig. 20, which is a view of the completed tunnel

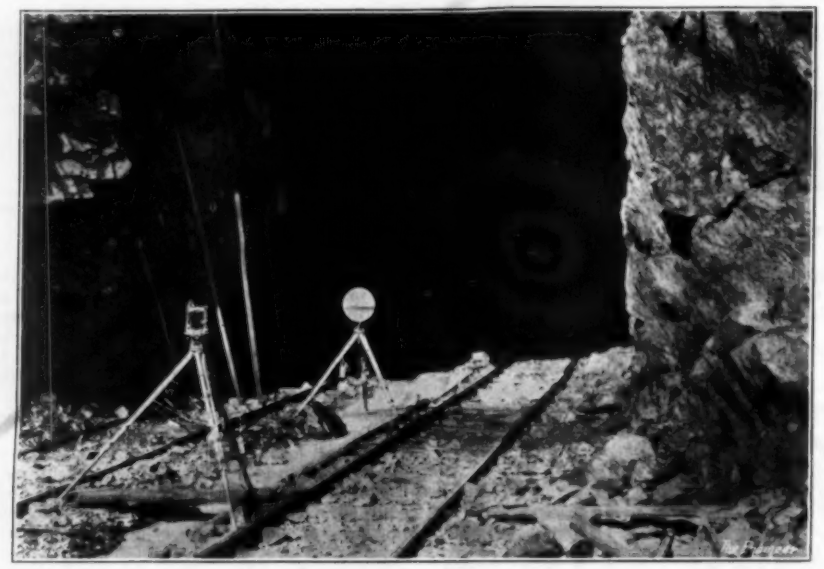


FIG. 20—COMPLETE ROCK TUNNEL AND "SUNFLOWER" INSTRUMENT

in hard rock where no timbering is required. In front is a transit for the surveys, and leaning against the rock at the left are the cross-section measuring rods and a levelling rod. The two lines of rails are of 3ft. gauge for the construction work.

PROGRESS OF WORK.

About 325 men are employed at the east end and 450 men at the west end, where the work is more difficult on account of the bad ground. A monthly record of progress in the headings and enlargement is given in the accompanying table. The highest record of advance is 1583ft. of 8ft. by 8ft. heading in solid rock in thirty days with three crews, or forty men in all. The unit cost of excavation in the pioneer tunnel and in the headings of the main tunnel averages £2 5s. 3d. per cubic yard. For the enlargement of the main headings to full tunnel section this cost is about £1 per cubic yard.

Moffat Railway Tunnel: Monthly Progress.

Length between portals, 32,383ft.

Date.	Pioneer or water tunnel.		Main or railway tunnel.			
			East end.		West end.	
	East heading.	West heading.	Heading.	Enl'gement.	Heading.	Enl'gement.
1923.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
September ..	—	32	—	—	—	—
October ..	76	295	—	—	—	—
November ..	367	610	—	—	—	—
December ..	638	972	26	—	—	—
1924.						
January ..	1,014	1,354	303	—	47	—
February ..	1,395	1,729	740	—	215	—
March ..	1,937	2,187	1,285	30	510	—
April	2,294	2,554	2,027	333	775	22
May	2,999	2,976	2,737	533	1,047	166
June	3,676	3,383	3,404	787	1,603	376
July	4,135	3,930	3,960	1,087	2,466	481
August ..	4,838	4,272	4,661	1,152	3,174	481
September ..	5,432	4,633	5,262	1,660	3,766	481
October ..	5,983	5,070	5,787	2,324	4,423	481
November ..	6,580	5,554	6,384	3,173	4,730	558
December ..	7,115	5,914	6,981	3,808	5,040	730
1925.						
January ..	7,785	6,167	7,653	4,360	5,605	958
February ..	8,137	6,767	8,112	4,890	6,238	1,072
March ..	8,638	7,147	8,629	5,423	6,565	1,388
April	9,326	7,431	9,320	5,987	6,936	1,782
May	10,068	7,735	10,091	6,543	7,354	2,175
June	10,707	8,246	10,725	7,042	7,606	2,370
July	11,484	8,938	11,497	7,574	8,455	2,720
August ..	12,101	9,335	12,108	8,420	9,150	3,090
September ..	12,696	9,670	12,708	9,253	9,548	3,488
October ..	13,264	10,188	13,237	10,255	10,155	3,959
November ..	13,805	10,484	13,757	11,017	10,427	4,311
December ..	14,246	11,022	14,222	11,649	10,969	4,652
1926.						
January ..	14,497	11,475	14,521	12,159	11,473	4,979
February ..	14,928	11,839	14,868	12,578	11,816	5,424
March ..	15,020	12,248	14,868	13,035	11,979	6,024

It was hoped that the headings of the two tunnels would meet this month, or about thirty-four months after the work was started, but the water trouble in February, noted above, may have reduced the rate of progress maintained up to March. In February the work completed totalled ten miles of heading 8ft. by 8ft., and 3½ miles of the full section of railway tunnel, this representing about two-thirds of the entire work. In April the situation was as follows:—The pioneer or water tunnel had been advanced 15,197ft. from the east portal and 12,318ft. from the west portal, a total of 27,515ft., or 85 per cent. of the entire work on this tunnel, with 4868ft. yet to be driven to connect the headings. Headings of the main or railway tunnel aggregated 14,868ft. at the east end and 12,038ft. at the west end, a total of 26,906ft., or 83.5 per cent. of the entire heading length. Enlargement of the main tunnel headings to the full section for the railway tunnel aggregated 13,209ft. at the east end and 6199ft. at the west end, a total of 19,408ft., or 60 per cent. of the enlargement. In all, the tunnel work, as a whole, was then a little more than two-thirds completed.

Production and the Production Engineer.

By G. W. TRIPP, A.C.G.I., A.M. Inst. C.E., M.I. Mech. E.

No. II.*

(2) KEEPING THE PROMISE.

IF the difficulties in making a promise are great, those in keeping it when made are greater, and everyone in the organisation must be brought to realise the importance of maintaining a good reputation in this sphere. If the work goes through its various stages without the slightest hitch, no notice is taken of the fact, other than for record purposes, but should any untoward incident arise, it must immediately be notified so that appropriate action may be taken, and the situation saved, if possible. It is the responsibility of the head of the section in which the failure occurs to notify the fact, and he does so on a "Broken Promise" form—Fig. 4—which is passed on to the next section,

BROKEN PROMISE REPORT.

The articles detailed below, promised for.....192.., will not be completed until.....192...., owing to the reasons given.

Works order No.	Nature of article.	No.	Reasons for amending delivery dates.

Date..... 192 . (Signed) .....
Foreman.

Noted in Production Office.
Date..... 192..
(Signed)..... .....
for Production Engineer.

(Signed) .....
Shop Superintendent.

FIG. 4—THE BROKEN PROMISE FORM

where it will then be decided whether there is a sufficient margin of time in which to make good the delay, or if the information must be passed to the next department. In the event of the final assembly shop being unable to meet requirements, the customer will be informed, with regret, that a modified promise has to be made, definite and cogent reasons being given. If this be done at the right time there is far less likelihood of subsequent friction between customer and manufacturer. In the early stages of the application of the scheme, it will probably be found that foremen and others are very averse from sending in broken promise forms, feeling as they do that the action will be regarded as a reflection on a colleague who will lose no time in trying to "get his own back." But if the management considers these cases sympathetically and trains the staff to realise that far more serious results attend a failure to submit a statement of the true facts of the case, and it is also appreciated that everything must eventually come to light, this natural reserve will vanish as the objects of the scheme are better understood.

We must now return to the production engineer and examine the means he should employ to assist the works in keeping promises of delivery. It is essential that he shall have some definite visible system of indicating all the work that is due for completion each week, and perhaps the simplest way of keeping him informed is to have a wooden framework with narrow longitudinal slats put vertically in it, each slat representing a definite week, and being provided with a series of hooks to which are hung pasteboard discs, each of which has a separate works order, for the jobs due for completion in that particular week. An indicator will be placed over the current week, and all work represented by the discs remaining to the left are overdue, as a disc is destroyed as the job is reported completed, while the discs to the right indicate jobs due for completion in the appropriate week in the future. By using discs of different colours various classes of product may be distinguished, and experience will readily suggest modifications to suit specialised requirements. The principle of the tally board is illustrated in Fig. 5.

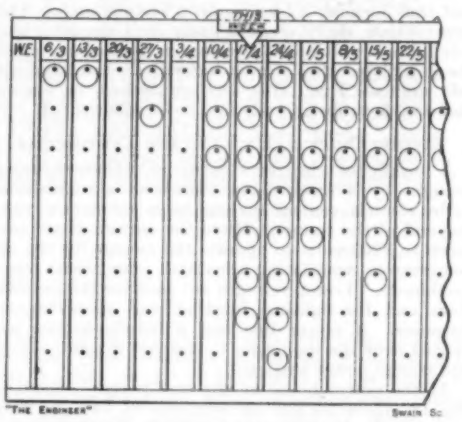


FIG. 5—PORTION OF PROGRESS TALLY BOARD

Needless to say, the production engineer will not rely on this board to help him to keep promises; it merely gives the ideal, and he must satisfy himself that work is keeping to schedule. For this purpose, it is convenient to watch monthly or even weekly expenditure obtained from the accounts branch week by week of the wages paid on each order. The amount is entered on a small card filed in his office, and is an invaluable guide—Fig. 6.

Works order ..... Date of order .... Duration....
Customers' order .... Date due..... Months .....
Estimate { Labour £.....
Man hours .....
Expended .....

Month.	Wages.	Man hours.	Month.	Wages.	Man hours.

FIG. 6—CARD FOR WATCHING PROGRESS OF WORK MONTH BY MONTH

In doubtful cases the production engineer or his assistant will take steps to ascertain the probability of work being finished to time, and if he elicits the fact that there is no prospect of a certain promise being kept, he ascertains if a broken promise form has reached him, and if it has he will make sure that the customer has been given a new date; if the amended promise has been accepted, he is entitled to move the disc to the appropriate week to the right, for it is virtually a new promise. If no broken promise form has been initiated, there will assuredly be trouble in store for a foreman somewhere. The keen shop superintendent and foreman will periodically visit the office of the production engineer to see the state of promises, and they will always be welcomed, and often receive valuable suggestions as to expedients to help them to regain lost ground, or they may have assurances that they will be helped to get components from other branches.

A considerable amount of statistical information will accumulate in the production department, which

* No. I. appeared July 9th.

will be wisely used for the purpose of propaganda among the staff and for fostering a keener spirit. As an example, a curve showing the number of broken promises for each section of the factory promotes a friendly rivalry under a judicious manager, leading to general improvement. To make the chart a fair criterion, it is better to plot the percentage of promises broken to the total number of those made for the week in question.

Many other records could be kept, and they will suggest themselves according to the nature of product—but here let a word of warning be raised; do not overdo this branch of the subject; production methods may easily result in too much paper work!

(3) ORGANISATION OF THE PRODUCTION DEPARTMENT.

The scope of the production engineer and his staff must be clearly defined, in order to avoid any chance of overlap or clashing of interest. If it be allowed that one of his main functions is to ensure smooth working which will result in systematic and regular production, he must be able to remove obstacles when they occur, and for that purpose he must have a definite standing in the organisation.

A fruitful source of delay is to be found in the initial stages of the work, and for this reason some concerns have allocated the tool-room, including the manufacture of jigs and gauges, to this official, while a few have gone even a stage further, and added pattern-making to his charge. Although there may be points in favour of adopting such a course, it is suggested that shop administration is better kept entirely distinct from "production," leaving the man in charge of the latter free to assume the *rôle* of a specialist, who seeks not only to cure the patient, but also to ensure a non-recurrence of the disease.

In a small business the production engineer will not be allowed much staff, but even without it he can accomplish a great deal. When, however, we have in mind a factory employing from three to five thousand direct producing operatives, engaged on a variety of different products, he will need a considerable amount of assistance. He will require an assistant with good engineering qualifications, capable of taking his place during his absences, a man of broad education being desirable, having considerable tact and personality. The production office itself will be manned by specially selected clerks, with shops or stores experience, both if possible, who can intelligently do all the logging and collating of the information furnished by the shop management. In regard to the hastening of work through the shops and extending a helping hand, obviously clerks are unsuitable, a tradesman having far more chance of success, provided he is able to understand the general make-up of the article, the relative importance of different operations, and possibilities of alternative methods. Indeed, he should have the power freely and fully to discuss the matter with an engineering foreman. Whether he is designated progress man, hustler, chaser, or router is a matter of individual preference. Although the headquarters of these individuals will be the production office, that will merely be for general convenience, for the bulk of their time will be spent in the works. They will have to follow up every order, seeing that the foreman has his material just when required, and, if not available, doing their best to obtain it, while if that is impossible they will report the matter as a check on the buying section, which should already have forwarded a broken promise form.

It might be as well here to digress to say that if, for administrative purposes, the buying and other organisations do not come under the same chief as the workshops, it is essential that they shall figure in the picture as regards production, initiating broken promise forms, &c., in exactly the same way as the shops would do.

The progress man will watch the work through all its stages, and do all in his power to facilitate satisfactory working. If he can smooth out all difficulties, well and good, but if not he must make a true report on the situation to the production engineer. He will keep a record of each job, *i.e.*, each works order, of its progress through its different stages, noting all broken promise reports and the steps taken by him to regain the ground that had been lost.

In a very large organisation it may be possible to have a specialist to look after each class of product, but in most cases only one or two men of a general all-round training can be afforded. They can be assisted very efficiently by apprentices who are nearing the close of their course, it being clearly understood that this privilege is only extended to youths who have shown particular zeal and given evidence of being able to think and act for themselves. Those who have been given a chance of work of this nature have almost invariably been grateful for the opportunity, and have subsequently confessed that it had proved most beneficial to them.

One of the aims of the production engineer will be to possess a complete history of each order, so that future orders may benefit by the experiences of past failures, and also so that all subsequent queries on the order may readily be answered.

While the organisation of a production department must necessarily be materially influenced by the nature of product, the magnitude of each order, and a number of other conditions incidental to a specific factory, it is submitted that all manufacturing concerns will benefit materially from having a production department as a recognised part of the administration. Justification for this statement may be found in the fact that such a function has met with success wherever installed on sound basic principles.

It is hoped that sufficient has been said to indicate the general lines that are essential, while sufficient has been left to the imagination of an individual who undertakes the installation of a system of production based on the substance of the foregoing article.

Inland Navigation and Water Power Exhibition at Basle.

THE City of Basle, standing where three nations meet at the head of the navigable portion of a great river, and forming the gateway to a country in which hydro-electric power is most abundant and intensely developed, would seem to be the natural spot in which to hold an International Exhibition of Inland Navigation and Water Power. An Exhibition there, which has just opened, was organised under the patronage of Herr Heinz Haeberlin, President of the Swiss Confederation, by the Cantonal Government of Basle, with the object of celebrating the completion of the new Rhine Harbour, which forms the terminus of the international waterway between Central Europe and the sea. The combination of the subjects of Inland Navigation and Water Power was not only indicated by local interests, but it had the advantage of giving the Exhibition a more international appeal. A country which is too flat to possess the waterfalls and rapid rivers required for the generation of water power is likely to be well adapted for the construction of canals and waterways, so that engineers concerned with the best utilisation of the natural waters of any country will find something to interest them at the Basle Exhibition. The Exhibition is being held in the Industries Fair Buildings, which consist of four large halls opening one into the other. The public was admitted on July 1st, after an unpretentious opening ceremony, but what may be regarded as the real opening function was not held until July 9th, when the Municipal Authorities of Basle welcomed the Federal and Parliamentary officials, the Exhibition Commissioners, and members of the Organisation Committee, the foreign diplomatic representatives, and delegates from the Federal Educational Institutions. The Exhibition will remain open until September 15th, and during this two and a-half months it will be the scene of almost daily meetings and conferences of technical and industrial associations. The most important meeting will undoubtedly be the Second World Power Conference, which will be held from August 31st to September 8th. The scope of this conference is more restricted than that of the First World Power Conference, held at Wembley in 1924, and has special reference to those matters with which the Basle Exhibition is concerned. It will, however, be sufficiently comprehensive to attract delegates from more than thirty-two countries, and about seventy papers will be presented for discussion.

At the Exhibition about fifteen different countries are represented officially or unofficially. Austria, Belgium, Czechoslovakia, France, Germany, Holland, Hungary, Italy, Poland, Spain, and Switzerland all have their national sections, and, in addition to these, there is in Hall IV. an imposing collection of machinery by manufacturers in various countries. Great Britain is only represented by a stand occupied by the Beama, where photographs and catalogues of the products of the constituent firms are to be seen. The stand, however, is presided over by a most accomplished linguist, so that information can be given to inquirers. One might have wished to see some indication of Great Britain as a manufacturing nation in the Machinery Hall, especially if some of the firms which are not constructing their machinery under licence from continental makers, could have been represented, so as to show examples of British design, but that apparently was found impossible to arrange. Furthermore, in the field of inland navigation we have at least the Manchester Ship Canal and Docks, even if the development of our smaller canals and navigable rivers is not all it might be, and the Exhibition of some illustrations or models of the Ship Canal might have been good business for the Port of Manchester, as well as consoling to national pride. Cities like Brussels and Ghent have seized the opportunity to advertise their aspects as inland ports without half as much justification as Manchester, while Amsterdam and Rotterdam have emphasised their harbour facilities by enormous models of their docks, 30ft. or 40ft. long, complete with ships and buildings to a scale of 1 : 1000.

The National and Official Exhibitions occupy Halls I., II. and III., and consist mostly of photographs, wall pictures and diagrams representing some aspect of inland navigation or water power. Floor space when occupied at all contains models of dams, ships, harbour machinery, hydro developments, &c. Such things do not lend themselves to an interesting description, and it would be tedious to review the exhibits country by country. It seems best therefore to indicate in a general way the scope of this part of the Exhibition by picking out for mention those subjects which strike a visitor as of special interest without regard to any particular order. Switzerland and Germany are probably the countries making the largest individual displays, Italy and France following closely. The immense importance of the Rhine as a means of transport is shown by the exhibits relating to that river and the great manufacturing cities along its course. In the German section are models of the cities of Mainz, Dusseldorf, Mannheim, Coblenz, &c., illustrating the water facilities, and the diagrams dealing with different aspects of this river and its traffic are very numerous. Belgium devotes most of its wall space to photographs showing the harbour equipment of Antwerp, Ghent and Brussels. A framed advertisement of tourist resorts on the Belgian State Railways is interesting, as pasted on the glass above the old and presumably pre-war figures, are the present season-ticket rates. When the advertisement was prepared, it was possible, for example, to obtain a fifteen-day first-class season ticket available over the whole system for 61·50 fr., whereas the current price is no less than 440 fr.—a striking example of the effects of the currency depreciation. Included in the Belgian section is a large exhibit of the Belgian Congo, with models of lake steamers, &c.; but perhaps the most interesting items are plans and models of Colonel Van Dearen's scheme for rendering the Congo river navigable by steamer from Matadi to Stanley Pool, a distance of 410 kiloms. His proposal includes the construction of seven locks, raising the level a total of 290 m. Spain shows about forty photographs and a model of the Chorro Dam at Malaga, which is a very striking piece of work. There is also a model of the Guadelete reinforced-concrete syphon, 2·5 m. internal diam. and 766·75 m. long, that carries water across a valley in which run two branches of a river. The syphon is buried except where it crosses each river-branch. At these places it rises in the form of an arch of 40 m. span with a clear height in the centre of 14 m. above the river. The outside diameter of these arched spans is 3·06 m. at the crown and 3·40 m. at the springings. This syphon is also illustrated by drawings and photographs. The exhibit of Hungary has a pathetic aspect, for among the most prominent items are maps comparing the size of the country and its water-borne traffic in 1923 with the corresponding conditions in 1913. How much the country has shrunk owing to the effects of the war may be illustrated by the fact that the 269 water gauging stations maintained from 1895 to 1919 were reduced to 92 in 1920. Poland, which exhibits maps and plans only, claims a total possible hydraulic development of 2,000,000 horse-power. Austria has an extensive exhibit of models and illustrations, and so has Czecho-slovakia. Holland shows, besides the wonderful models of Amsterdam and Rotterdam Harbours, already mentioned, some striking models of cranes and harbour equipment. The French exhibit comprises stands and wall space taken by Chambers of Commerce of various cities, shipping organisations, railway companies, &c., besides those of several manufacturers. Among the apparatus shown are lighthouse lenses, ropes and ropework, electrical apparatus, cables, &c. The most interesting exhibits of Italy are to be found in the machinery hall, which will be referred to later. The United States are only represented by a few photographs sent by the Federal Power Commission and the United States Geological Survey, while other countries with notable hydro-electric developments, such as Canada, Sweden, Japan, &c., do not seem to be in evidence at all.

Switzerland, as might be expected, makes a fine show, both in the general Exhibition and in the Machinery Hall. A country with a population of 3,920,000 inhabitants, which produces annually 3850 million-kilowatt hours of hydro-electric power, or 980 kilowatt-hours per head, could hardly fail to have something to exhibit as regards hydro-electric matters. Of the power produced, 750 million kilowatt-hours per annum are generated by the electro-chemical industries; 200 million kilowatt-hours by other industries; 170 million are at present used by the railways, though a consumption of from 500 to 600 million is finally anticipated for this purpose; 2075 million are distributed for general purposes, and 655 million are exported. The investment in the power industry is about 1200 million gold francs, and consumers have invested another 800 million gold francs in their apparatus. The diagrams, &c., dealing with the Swiss electrical industry are too numerous to mention, though a few words may be said about an interesting type of model illustrating the nature of the annual load. The load curves for every Friday, Saturday, Sunday and Monday throughout the year are cut out as profiles on plates of transparent celluloid. These are suitably spaced side by side in a glass case forming a kind of skeleton of a solid model. Looked at from the end, the variation in the daily load factor can be seen, while looked at sideways, *i.e.*, facing the edges of the individual plates, the variation of load throughout the year can be observed. Along the side of the glass case are two lines, one representing the mean daily load throughout the year, and the other the power available. The former curve is above the latter from the beginning of December to the beginning of April, showing that during this period storage water has to be partially relied on. At present the power utilised in a year is 72 per cent. of that available from the developments so far completed.

In the Swiss Section is a large exhibit staged by the Engineering School of the University of Lausanne.

Here are to be seen working models of the low-head —5 m. to 8 m.—turbine installation at Chèvres and a high-head—1650 m.—Pelton wheel installation at Fully, which are connected by a high-tension transmission line 140 kiloms. in length and work in conjunction with each other. The Fully plant starts up automatically when the Chèvres plant is unable to cope with the load. The former was designed by Mr. A. Boncher, and the latter by the late Monsieur T. Turrettini, both graduates of the Lausanne School. Other exhibits include specimens of turbine buckets, needle valves, &c., cut away in curious fashion by the sand in suspension in the water. There are also some historical relics, such as a Burgin D.C. dynamo built in 1883, a 10 kilovolt-ampère transformer by Ganz, reducing from 2000 volts to 100 volts, built in 1886, and a turbine with a wooden rotor. The testing laboratory of the school contributes samples of concrete taken from the Barberini Dam, showing the effect of the fluidity of concrete on its compactness when set and on the resistance of joints. There is also a large fatigue testing machine for ferro-concrete beams, allowing loads up to 1200 kilos. to be applied at one or two points two and a-half times per minute. To study the effects of different metals, &c., on the wear of gear teeth, there is a machine in which two discs, 30 mm. thick and 100 mm. diameter, run in contact edge to edge under a pressure regulated by a spring. The spindles on which the discs are mounted are coupled together by elliptical gear wheels, so that the discs have a partly sliding and partly rolling motion on each other, which imitates the mutual action of gear teeth. Another testing machine has for its object the determination of the water-tightness of concrete slabs. The slab to be tested is held between two hollow-faced clamps provided with suitable packing round their edges, and a water pressure up to 100 atmospheres is maintained on one side for a given length of time. The water which finds its way through the slab runs down a funnel-shaped pipe connected to the lower cramp, and drips into a graduated glass.

Great as is the educational interest of these and other of the Swiss exhibits, it must be admitted that, so far as the study of hydraulic problems is concerned, the Germans make the best show of their enterprise in this direction. The Shipbuilding Research Institute at Hamburg shows a tank containing a moored model of a steamer, fitted with apparatus for measuring the torque and thrust of the propeller at various speeds. The Hamburg Institute, it may be mentioned, has an experimental tank about twice as large as the N.P.L. tank at Teddington, and the services of its staff are requisitioned by more than one firm of British shipbuilders. Other German organisations showing apparatus for, or illustrating the results obtained from various researches in hydraulics, are the Prussian Wasserbau Versuchanstalt, of Berlin, and the Technical High Schools of Dresden, Karlsruhe, Hanover, Berlin and Munich. Some of their exhibits are extremely interesting, and, taken together, they indicate unmistakably with what patience and intensity hydraulic problems are being studied in Germany. One of the working models represents a proposed type of canal designed to avoid any loss of time in passing locks. As the ascending vessel enters the lower lock gates they automatically close behind it and the upper gates open. The lock is very long, so long, in fact, that by the time the vessel has reached the upper gates, the lock is full and the vessel passes on without stopping. Naturally such a scheme would only be practicable where there is a very abundant supply of water, because of the size of the locks required. Another working model is a glass-sided tank divided by a transverse partition into two compartments. In each compartment is the stern portion of a vessel, the vessels being exactly alike except that one has a single propeller and the other twin propellers. The bottom of the tank is covered with loose sand, and when the propellers are set in motion, the disturbance of the sand by the single propeller shows how much less erosion would be caused to a canal bottom by twin-propeller vessels.

Much space is given to models and diagrams showing the erosion of water channels and of the river bed on the downstream side of dams of various kinds. In addition to a working model, on which the disturbance of the sandy bottom by the water flowing over a weir can be actually observed experimentally, there are numerous wooden models of river beds, carved, coloured and contoured to show the form assumed by the bed owing to the action of the water. Much study has also been given to the effect of round, square, lozenge-shaped, stream-lined, and other forms of obstruction, such as might be used as bridge piers. Here again are numerous diagrams, tinted and contoured to show the nature of the erosion which takes place round such obstructions. Other diagrams show the converse, namely, the silting up which takes place, as a result of the flow of water carrying suspended material, being affected by groynes, harbour walls, &c. The deposits formed at the mouth of the Kiel Canal are also illustrated. Dr. Prandtl, of Gottingen, shows a series of remarkable photographs depicting the nature of the flow when cylinders, either stationary or rotating at different speeds, are interposed in a stream of fluid. His researches in this connection have made clear what happens when the towers of the Flettner rotor ship are caused to rotate when a breeze is blowing, and how it is that the ship is propelled. They also bear very closely on the action of air on an aeroplane wing and indicate how the latter is supported in flight. Dr. Prandtl, indeed, shows photographs which demonstrate the nature of the eddies round obstructions of aeroplane section. A very interesting working model on the same stand consists of a narrow rectangular tank having a "waist" in it formed by curved cofferdams extending towards the centre from the sides. The channel left between the cofferdams has an easy entrance, but a more abrupt exit shape, the contour being much like that of a Venturi meter pipe with the water flowing backwards through it. When a flow is established down the tank it is of streamline form as far as the throat, but eddies are formed where the flow diverges again. This is made evident by sprinkling aluminium powder on the water as it enters the constricted portion of the tank. In the downstream sides of the cofferdams are vertical ports, putting the inside of the cofferdams into communication with the main flow. If the water level inside the cofferdams is lowered there is a flow of the eddying water into the cofferdam through these ports, with the result that the eddies immediately subside and the whole flow through the tank becomes of a streamline nature.

Heavy Machinery.

Hall number IV. is, as has been mentioned, devoted almost entirely to the exhibition of heavy machinery and commercial apparatus. The nations which share practically the whole of the stands between them are Switzerland, Italy, and Germany. Some very fine examples of water turbine work are shown. The Costruzioni Meccaniche Riva, of Milan, has on its stand a Pelton type turbine which is claimed to be the largest single-wheel machine yet constructed in Italy. This turbine, which is for the Meze power station, will develop 35,000 horse-power at 420 to 500 revolutions per minute, working under a head of 740 m. and taking 4400 litres of water per second. Opposite to this is a two-wheel 40,000 horse-power Pelton turbine built by Franco Tosi for the Naples Hydro-electric Company. The turbine develops its power at 440 to 460 revolutions per minute and takes 7000 litres of water per second at a pressure of 500 m. The Ateliers des Charmilles, of Geneva, show a 20,000 horse-power Pelton turbine to work at 333 revolutions per minute with a 640 m. fall, for the Swiss Federal Railways. Escher, Wyss and Co., of Zurich, show a Kaplan turbine to develop 3120 horse-power at 167 revolutions per minute with a fall of 8·2 m., and a Francis runner to develop 30,000 horse-power at 360 revolutions per minute with a 130 m. fall. What appears to be quite the biggest turbine in the Exhibition in point of size is a propeller type of turbine to develop 9500 horse-power, built by J. M. Vorth, of Heidenheim, but neither the head nor the speed is stated.

As might be expected, pipe line work is shown by several firms. Messrs. Rieser and Co., of Berne, and the Holzrohrban Company, of Freiberg, show wood stave pipe, the former exhibiting a section of pipe no less than 3200 mm. diameter, to work under a pressure of 30 lb. per square inch. The staves are about 2½in. thick and 3in. wide, held together by ¾in. iron buckle rods at about 2½in. centres. The Mannesmann Company shows some fine examples of steel pipe work, among which is a breeches piece leading from 1500 mm. diameter to two branches of 1050 mm. diameter in 4 m. This piece is for a working pressure of 30 atmospheres and weighs 7370 kilos., the thickness of the metal being 30 mm. A straight length of pipe strengthened with shrunk-on hoops, tested to a pressure of 200 atmospheres, and for a normal working pressure of half that amount, is exhibited. This pipe is about 1200 mm. diameter and about 45 mm. thick. It has a circumferential riveted butt joint in the centre, the joint being covered by an extra wide hoop and held together by eight rows of rivets. The heavy pipes shown by Thyssens are lap welded, among them being a specimen 5 m. long, 1380 mm. diameter by 57 mm. wall thickness. This was made for a working pressure of 66 atmospheres and a test pressure of 100 atmospheres. It is sectioned to show the weld. Messrs. Thyssen, who make a speciality of heavy lap-welding work, also show a lap-welded boiler drum with a wall thickness of 88 mm., increased to 145 mm. at the bottled-in ends. The inner diam. is 1244 mm. and the length 4740 mm. This drum was for a working pressure of 90 atmospheres, and a test pressure of 260 atmospheres, this latter imposing a tensile stress of 16·6 kilos. per square millimetre on the metal. After the test the finished drum was annealed. The specimen shown has, like the pipe above mentioned, been sectioned along the weld to show the perfection of the latter. The welding is done by water gas, in the same way that pipes of less thickness are often made. The Press and Walzwerk Company, of Düsseldorf, is showing drawn pipes of considerable magnitude, also square, round, and D-shaped hollow drawn sections for superheater headers, mud drums, &c.

Amongst the exhibitors of switchgear and kindred apparatus may be mentioned Messrs. Sprecher and Schuh, of Aaran, who show two poles of a three-pole circuit breaker to work at a pressure of 87 kilovolts and to rupture a power of 600,000 kilovolt-ampères. Carl Maier and Co., of Schaffhausen, show similar apparatus to work at 150,000 volts, with an interruptive capacity of 500,000 kilovolt-ampères. Messrs. Trub Tauber and Co., of Zurich, show an electrostatic voltmeter calibrated up to 350,000 volts and numerous other instruments, including a seismograph. Electric cables for very high pressures are shown by Messrs. Pirelli, of Milan. The exhibits culminate in a sample of single-core cables with a conductor section of 50 square millimetres for a working pressure of 130,000 volts. Some underground cable for this pressure has been installed in Italy by the Società Elettrica Interregionale. The conductor is a hollow strand of copper wires, surrounding a helical wound wire of what looks like galvanised iron. The method of jointing such a cable is shown on the stand.

Electric locomotives of various types are arranged on a length of track extending outside the hall. There are altogether seven of these machines by various makers. For the Italian lines the typical passenger locomotive appears to be of the 2–8–2 type, weighing rather over 90 tons in running order. Italy uses three-phase current for railway work; the locomotives are therefore built to collect and utilise this current at 10,000 volts. The aggregate power of the motors is about 2000 kilowatts, and the standard speeds are 37·5, 50, 75, and 100 kiloms. per hour. Perhaps the most interesting vehicle is a portable sub-station to transform 100,000-volt current to 3700 volts. The transformers are rated at 2250 kilovolt-ampères, 16·7 cycles. The vehicle complete weighs 90 tons and runs on two bogies. There are various exhibits in the machinery hall which hardly seem to be covered by the title of the Exhibition, such as flour milling machinery, grain elevating machinery, &c. Machine tools are represented by Messrs. Stock and Co., of Berlin, who show milling and drilling machines of several kinds. The famous Swiss firm of Sulzer Brothers, of Winterthur, shows examples of the Diesel engines and pumps for which it is noted. Its engines, which are in working order, include a six-cylinder, two-cycle 300 horse-power engine with piston scavenging, and an 80 horse-power engine with four cylinders employing crank case scavenging. Mention should also be made of the exhibit of the Swiss Locomotive Works of Winterthur, which shows rotary air compressors, both motor-driven and petrol engine-driven, the latter being portable machines for supplying air to pneumatic tools, &c.

Royal Agricultural Society's Show at Reading.

No. II.*

Much has been heard recently of the great developments which the future is to witness in connection with the application of electrical energy as the motive power for agricultural operations. In the paper which Mr. Ayton read at the meeting of the Institution of Mechanical Engineers at Ipswich last month the author, after stating that there was no real difficulty in substituting an electric motor for a steam or oil engine for the purpose of driving a cable winding drum, expressed a doubt whether the new source of power possessed such advantages over its rivals as would offset the trouble and expense of erecting overhead supply wires to the different arable fields on a farm, assuming, of course, that the farm is in such a position that it can command a supply of electrical energy from some public supply system.

Another point which, Mr. Ayton said, had to be borne in mind was that most of the steam ploughing tackles were operated by contractors who travelled from farm to farm, and it was not likely, until all farms in a neighbourhood were electrified, and provided with supply connections to the different fields, that the ploughing contractor would look with favour upon a type of plant which, even though in cost of operation it compared favourably with steam or internal combustion engines, had to depend upon some other means than electricity to haul it from place to place. A considerable time, therefore, would probably elapse before electrical haulage makes much headway in the farming industry; still there was no valid reason why electrical energy, whether generated on the farm or obtained from local sources of supply, should not find a more general application for operating the stationary machinery on farms and estates, such, for instance, as grinding and crushing mills, root and chaff cutters, pumps and dairy machinery.

These remarks are most appropriate at the present moment, for some makers of agricultural and dairy machinery have been "nibbling" at the application of electric motors to farm machinery for some time, and the Reading Show was probably the first at which such a display of electrically driven appliances had been seen as that on the stand of Ransomes, Sims and Jefferies, Ltd., Ipswich, who devoted a complete bay to motors driving various appliances which are in common use, such as a root cleaner, and end-over-end churn and a cream separator. The motor which drives the two latter appliances is only ¼ horse-power, the root cleaner and cutter being driven by a separate ½ horse-power motor. In addition to the small motors mentioned, there was a 10 horse-power motor driving a thrashing machine, a 4 brake horse-power direct-current agricultural motor and a 5 brake horse-power alternating-current squirrel-cage induction motor.

* No. I. appeared July 9th.

The generating set comprised one of Ransomes' 3¾-kilowatt, 200 volts direct-current generator and a 7 brake horse-power Ruston petrol-paraffin engine. The firm also showed a 6 nominal horse-power compound traction engine and a 4 nominal horse-power compound steam tractor. The thrashing machines made by this firm were represented by a 54in. medium machine on iron wheels, with a 22in. drum, ball bearings throughout and the usual accessories. This type of machine is specially intended for the use of contractors. Other thrashers of a lighter type included a 54in. machine, specially adapted for use with a tractor, and a 42in. machine with first and second dressers, bucket elevator, and the ordinary equipment. Both these machines have iron wheels and are said to produce first-class samples of grain without further dressing.

driven by a small petrol engine, but in many cases electric motors are used.

In connection with the cream separators of R. A. Lister and Co., Ltd., of Dursley, a new attachment for milk clarifying was shown. This consists of a bowl in two portions, in which are placed the false top, distributor and plates—Fig. 14—from four to eight in number, according to the size of the machine. The milk is run through in the ordinary way as when separating, and the dirt and dust particles are retained inside the bowl in the space provided for the accumulation of impurities. This space is large and allows for a long run without stopping. The clarifier plates, being few in number, can be easily and quickly washed, and the clarifying is said in no way to affect the milk except by removing all bacteria-carrying elements.

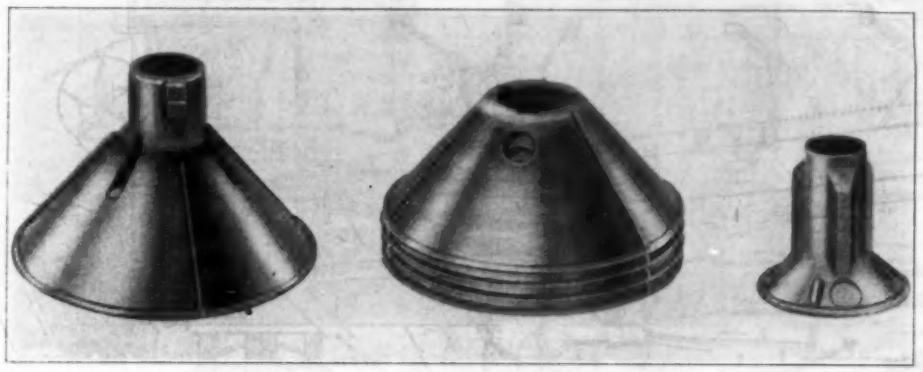


FIG. 14—BOWL PLATES FOR MILK CLARIFIER—LISTER

An exhibit of an unusual type on the stand of Robert Boby, Ltd., Bury St. Edmunds, was a flax-pulling machine, by means of which, it is claimed, the flax is pulled and gathered in a superior condition to that which is obtained manually. The Boby machine is designed on the same general lines as other harvesting appliances and resembles an ordinary mowing machine. The pulling mechanism is adjustable by hand for setting it at varying heights from the ground level so that it will pull long flax or short flax, the grip being taken just below the seed heads at precisely the same height as that at which the hand puller grasps the stems. The dividers which govern the width of the swath to be pulled are also operated by hand and allow extension or contraction within a range of 16in. to 25in. Briefly, the method of working is as follows:—The machine is provided with a series of movable needles or fingers which enter a strip of growing flax as the machine travels forward alongside, and are so designed as to raise the growing flax from any position to a vertical standing. By this means the flax is raised clear of all weeds and is prepared for the subsequent pulling operation. Special dividers gather in the flax and feed it into the mouth of the puller. During this process of feeding it is impossible for the flax to become removed from its vertical position; neither can it fall backwards or forwards nor escape from the pulling position.

The actual pulling is done by two special belts running over pulleys. These belts are held in contact at a tension sufficient to pull the flax out of the ground, but not to tear or destroy the tissues of the plant. The action of these special belts gives a grip on the flax equivalent to that of the hand puller. The pulled flax is deposited on to a grid platform, from whence it is tipped in loose sheaves on to the ground in a level even layer and with the straw in a straight direction, and it is laid at the side of the track of the machine, leaving a clear passage-way without its having to be removed.

As is well known, the flaxes of different countries are of different textures, which necessitate slightly different tension on the pulling belts, to suit various localities. A simple regulating device is therefore fitted to all machines to enable the user to adjust the tension of the belts to suit any particular kind of flax. The capacity of the machine is from 4 to 6 acres per day, from which fact those interested can calculate the saving effected as compared with the cost of flax pulling by hand labour. The machine can be worked by one or two horses, as may be preferred by the user and according to the lie of the land. It weighs about 12 cwt.

Considerable numbers of milking machines of various makes have been tried in the past, and many of them have been abandoned after use for one or more years because of injury to the cows or reduced milk yield. The Alfa-Laval machine claims to have overcome these objections. The machine is exceedingly simple, and a novel feature in it from an engineering point of view is the introduction of a rotary vacuum pump, an innovation which has led to the abandonment of tanks to damp out the pulsations created by using a reciprocating pump. Two pipe lines, which are led over the heads of the cows, are used. In one pipe vacuum is maintained, whilst the other transmits the pulse for operating the teat cups and milking the cows. All the cows are therefore milked at the same rate. The plants are generally

In addition to their customary extensive display of electric lighting and power plants, Messrs. Lister showed a new 16 horse-power paraffin engine—Fig. 15—in which a special feature is made of the method of lubrication. It comprises an oil box in which a constant level of the lubricant is maintained by means of a pump and overflow in a similar manner to the fuel feed in a carburetter. From each bearing a pipe is connected to a separate cup formed in the oil box. A

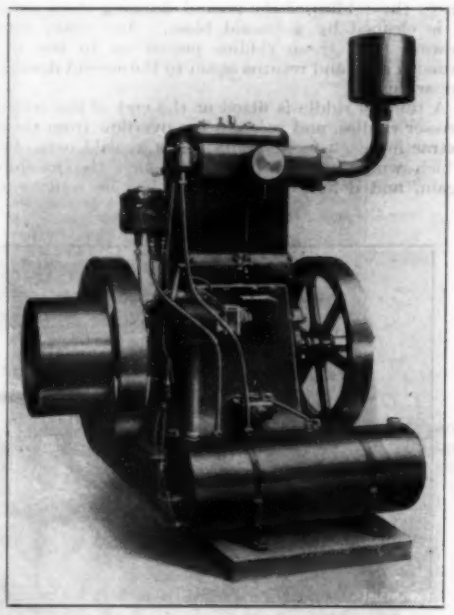


FIG. 15—16 H.P. PARAFFIN ENGINE—LISTER

trip bar with adjustable splashers is operated by means of a ratchet and excentric, and they throw a small quantity of oil into the cups, the amount of which can be varied.

J. and H. McLaren, Ltd., Leeds, showed a 60–70 brake horse-power oil motor windlass, one of a pair intended for ploughing on the cable system; a 20 nominal horse-power compound steam ploughing engine; a compound 10-ton steam roller; and an agricultural traction engine. The 60 horse-power motor windlass has a four-cylinder engine and the firm's re-starting gear, which permits one of the engines to remain stationary while ploughing. A five to six-furrow anti-balance plough for use either with a motor windlass tackle or steam ploughing engines is fitted with McLaren's regulator gear, the object of which is to get over the difficulty and trouble of tipping the anti-balance plough at the end of the furrow and of throwing it over on to the new land. This appliance has now been on the market for some time. By an arrangement of steel rope or chain fastened at one end to the lower part of the spring middle and passing over a series of pulleys carried on the plough frame, forward or rearward of the travelling wheels, and attached to the upper end of the middle frame, the axis on which the travelling wheels turn is caused to move to the same extent as the swing of the plough middle so that the plough is thrown into balance. In tipping the plough when the middle frame reaches the vertical position, the centres on which it and the travelling wheels respectively turn, are in the same transverse vertical plane, and the two ends of the plough are in balance, so that very little force is necessary to swing the plough horizontally to the required position on the unploughed land. As soon therefore, as the tail rope commences to pull there is caused a movement of the centre on which the middle frame turns until the plough is brought into balance and is easily tipped.

One of the most novel exhibits in the implement section was furnished by Hathorn, Davey and Co., Ltd., Leeds. It was a simple and efficient form of pump in which the screw and centrifugal principles are combined. It is claimed by the exhibitors that instead of the normal centrifugal characteristic in which the power demanded by the pump increases as the head against the pump diminishes, in the "Helivane" pump, although the head should fall to zero, the motive medium cannot be overloaded, and, in fact, the load is the least when the head vanishes. A view of the vertical pump and the impeller and body is given in Fig. 16. This is the 8in. size, and at a speed of 1350 revolutions per minute the pump was throwing 60,000 gallons per hour against a head of 16ft. The duty required 8 horse-power. The water passages are made large so that the pump may not be liable to choke. The impeller is mounted on the lower end of a spindle, the upper end of which is supported in a ball thrust bearing. The pump can be made in a great variety of sizes from 3in. upwards and is designed for any delivery from, say, 100 gallons per minute

FIG. 16—THE "HELIVANE" PUMP—HATHORN, DAVEY

against heads up to 40ft. It can be made either vertical or horizontal, but the vertical arrangement allows the impeller to be placed below the suction level and thus avoid the necessity of priming.

A horse-drawn mowing machine shown by Bamfords, Ltd., Uttoxeter, is claimed by the makers to be an improvement in two essential details over other mowers. In the first place, it is fitted with curved spiral bevel gearing instead of the usual straight bevels, by which it is claimed the machine runs more noiselessly, while a smoother motion is transmitted to the cutter bar. The makers further claim that this gearing minimises the possibility of breakage of the knives and reduces the wear on the knife heel. The other new feature of this machine is an improved auxiliary swath board which is detachably secured to the inner or main shoe end of the finger bar for cutting the first swath. By this means the swath is laid clear of the uncut grass and leaves a good track for the horses and machine when cutting the "back" swath. The board is pivoted to rise or fall with the inequalities of the ground, but the downward movement is restricted so that when the cutter bar is lifted the track clearer is prevented from digging into the ground with liability to breakage. By means of this appliance the hand labour which has hitherto been necessary for raking the first swath away from the standing crop is dispensed with and time is saved.

Messrs. Bamford also exhibited a 10 brake horse-power horizontal paraffin engine of simple design. It has a special valve gear which enables both the inlet and exhaust valves to be operated mechanically through the medium of one cam, one rod, and one rocker arm. The exhaust valve is operated through a rod in tension instead of compression, thus enabling lighter parts to be used and cutting out the tendency of the valve rod to buckle and vibrate. Both valves are situated in the combustion chamber head in a radial direction, and the valve heads are shaped to conform to the contour of the chamber, which is cast hemispherically. The incoming mixture is heated by the combustion head face and before entering the cylinder it is projected on to a hot spot adjacent to the exhaust valve, so as to ensure complete vaporisation

of the fuel. The combustion head is readily detachable from the cylinder by removal of five nuts.

A new combined swath turner and side rake of unconventional design was shown by Harrison, McGregor and Co., Ltd., of Leigh. One of the outstanding features of this new implement is the efficient manner in which it turns the swath, its action being similar to hand raking; that is, it completely turns the swath. The motion of the tine is obtained through a multiple-throw crank and slide rods, which impart the correct action for raking. The control levers are conveniently placed, one on either side of the seat and in close proximity to the driver's hands. The gearing is of the involute type, consisting of acute-angled bevel gears and internal spur wheel and pinion.

Weighing appliances of various kinds were exhibited by Messrs. Avery. One of the most ingenious and useful machines which we noticed was a cattle weigh-bridge with a weighing capacity of 30 cwt. It is fitted with automatic dial indicating mechanism, the dial being graduated up to 30 cwt. by 7 lb. divisions. It is constructed without springs and neither water, oil, nor any other liquid is used in indicating the weight.

William Foster and Co., Ltd., Lincoln, were represented at Reading by a single-cylinder agricultural traction engine with the latest improvements, and particularly intended for thrashing contractors, a 5-ton compound steam tractor with special spring mounting and rubber-tired travelling wheels, and a 4ft. 6in. thrashing and finishing machine, with a 22in. iron drum and reversible steel beater plates. This machine is fitted with ball bearings throughout, and with an improved awner, reversible screen and concave, and it has a main blower made in two sections. A sectional view of the Foster thrasher is given in Fig. 17. In this illustration, A is the drum, B the concave, C the straw shakers, D the top shoe, E the bottom shoe, F the first dresser fan, G the chaff spout, H the corn spout, I elevator cups, K the awner and smutter, L the second dresser, M the second dresser fan, N the rotary separating screen, O corn outlets, and P the tailings spout. The riddles are as follows:—1 cavings riddle, 2 wind riddle, 3 capes riddle, 4 seed sieve, 5 chaff sieve, 6 second dresser riddles, and 7 the tailings riddle. The awner consists of a long barrel with a conical head or smutter. The awner spindle is fitted with a worm and blade conveyor and a set of wrought iron adjustable beaters. The beaters have a wide range of adjustment for dealing with all kinds and conditions of grain. To regulate the flow of grain, a hinged valve is fitted at the conical head. Valves are provided in the awner barrel, so that grain may be delivered from the elevators (i.) through both awner and smutter, thence through the second dresser box to the rotary screen; (ii.) through the awner into the dresser box without passing through the smutter; (iii.) direct into the second dresser box, avoiding the awner and smutter; and (iv.) direct into the bagging hopper. All the levers for operating these valves are placed on the outside of the machine. After passing through the awner the grain is delivered on to the riddles of the second dressing shoe, where it is cleaned by a second blast. Any grain overflowing from these riddles passes on to the first dressing shoe and returns again to the second dressing apparatus.

A tailings riddle is fitted at the end of the second dresser riddles, and receives the overflow from them, extracting such foreign substances as wild oats, &c., which would otherwise pass through the machine again, and delivers them into a bag or scuttle for removal. The market sample is obtained by the final operation of passing the grain through an adjustable rotary corn screen. This operation removes small and defective grain in addition to grading the corn as desired. The spindle of the screen brush is carried through the frame, so as to enable the ends to be oiled from the outside. Three spirit levels are provided for setting the machine level for working, one being fixed on the driving side and one at each end of the thrasher. The frames of the machine are of oak stiffened by two diagonal iron trusses and boarded with deal.

The Crossley exhibits included a horizontal heavy fuel oil engine, 66 brake horse-power, also several two-stroke fuel oil engines and numerous paraffin and petrol engines, all of which have been previously described in our columns. A new development embraces a number of 2 brake horse-power and 3 brake horse-power small horizontal oil engines as illustrated in Fig. 18. As exhibited they are arranged for hopper cooling, tank cooling, and as portable sets. In addition, an engine is fitted with radiator cooling and is used for driving a 1½-kilowatt dynamo, fitted complete with switchboard, and suitable as a country house lighting set. This type of small horizontal engine has certain distinctive features in its design, being totally enclosed and fitted with automatic oiling supplied from a sump lubricator, which operates with remarkable economy and renders the engine suitable for continuous operation. It represents a distinct advance upon the usual small American paraffin and petrol engine with which it is intended to compete. Increased efficiency is effected by the mechanically operated inlet and exhaust valves, both of which are worked from a single cam and push-rod. A high-tension magneto is fitted, also disc fly-wheels, and the engine presents a very compact appearance. Another interesting feature is the Crossley 5-ton locomotive—Fig. 20—2ft. gauge, fitted with 30 horse-power paraffin engine. We are informed that numbers of these locomotives have been working very successfully in this country during the past two years. A 10-ton agricultural tractor fitted with a paraffin engine of 20–25 brake horse-power, was exhibited, and although the home demand for agricultural tractors is limited they are in successful operation in many places. A further use for these tractors is in connection with transport work. In such cases the tractor is fitted with rubber-tired wheels as illustrated in Fig. 19.

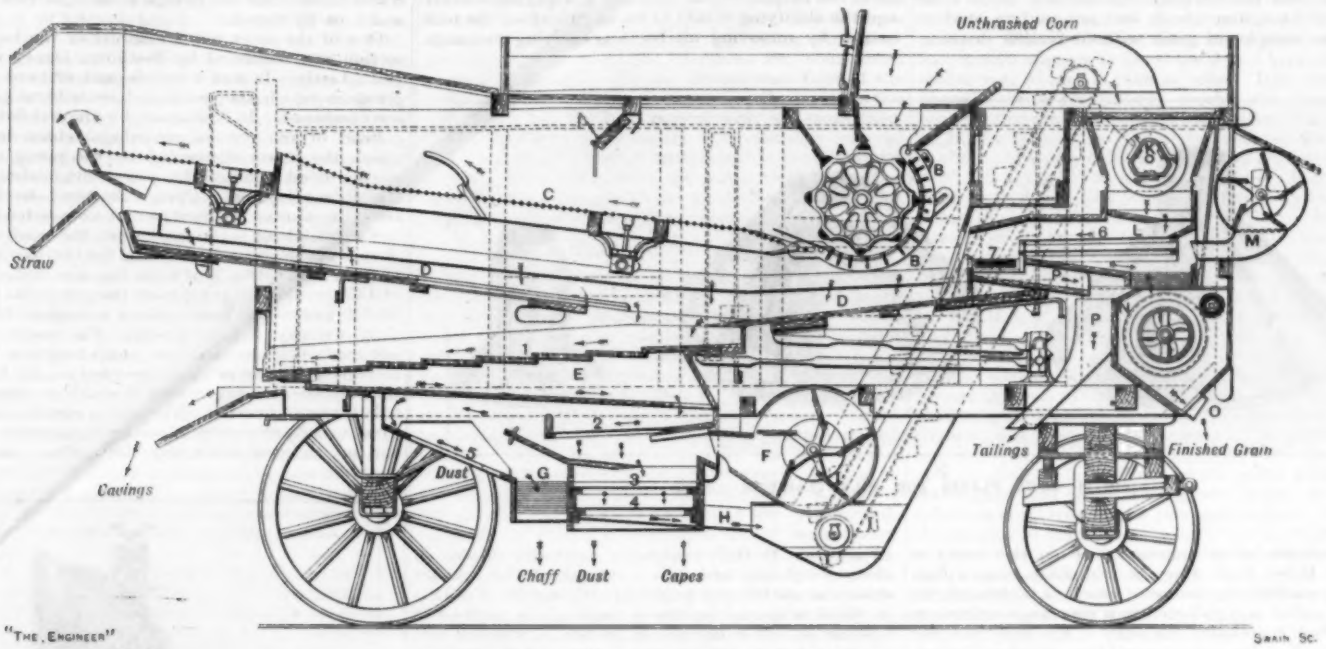


FIG. 17—THRASHING AND FINISHING MACHINE—FOSTER

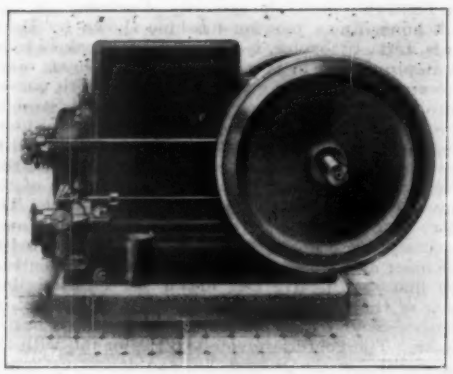


FIG. 18—2 B.H.P. OIL ENGINE—CROSSLEY

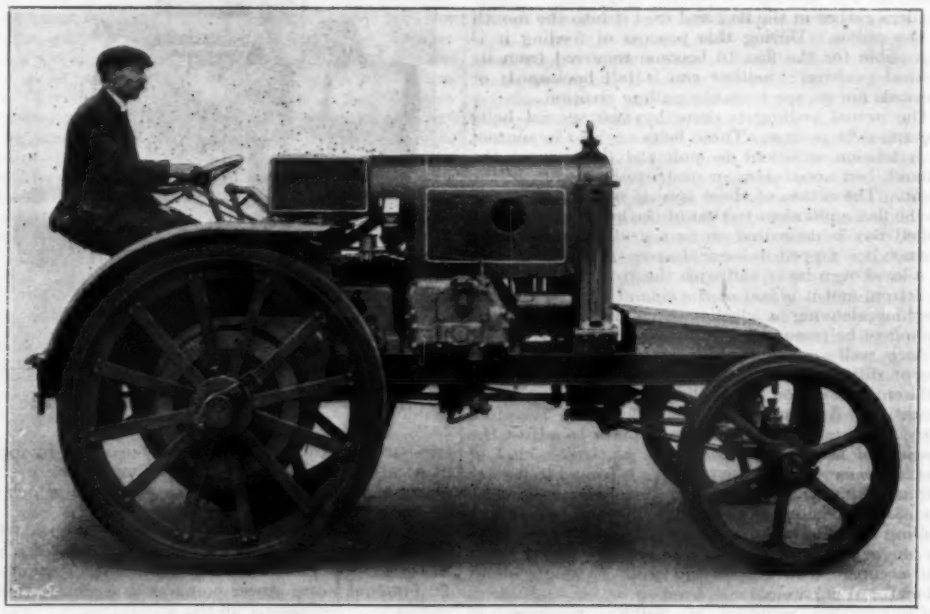


FIG. 19—10-TON AGRICULTURAL TRACTOR—CROSSLEY

This firm also showed a water weed cutting launch for use for clearing weeds in rivers, lakes and dykes. The motive power is used for propulsion and for operating the cutting knives, the speed of cutting being at the rate of 2½ miles per hour.

Crossley's vertical two-stroke engine was fully described in our issue of January 22nd last. Since this is the first time we have seen such small engines started by low-compression ignition, and it marks a further development in starting methods.

A 6-ton steam wagon shown by the Yorkshire Patent Steam Wagon Company, Leeds, and illustraded in Figs. 21, 22 and 23, contains many new features which are being introduced with the object of providing a vehicle capable of covering a wide range of duties, including high road speeds. At first sight it might be said that the machine resembles very closely its predecessors, and that is true, inasmuch as its designers have retained the horizontal boiler, which has always been a feature of the Yorkshire Steam Wagon Company's vehicles, as well as the vertical engine. On going further into the details, however, it is found that there are many important deviations from the original. The boiler is constructed for a working pressure of 215 lb., and the superheaters are disposed at either end in the smoke-box doors, being designed so that there may not be any difficulty in sweeping the tubes. The main alteration in the boiler is the re-arrangement of the fittings to suit the driver. For feed purposes both an injector attached direct and a feed pump are provided. The latter is gear driven and can be used when the wagon is running or standing. This boiler is very accessible for washing out and is claimed not to be liable to trouble from leaky tubes.

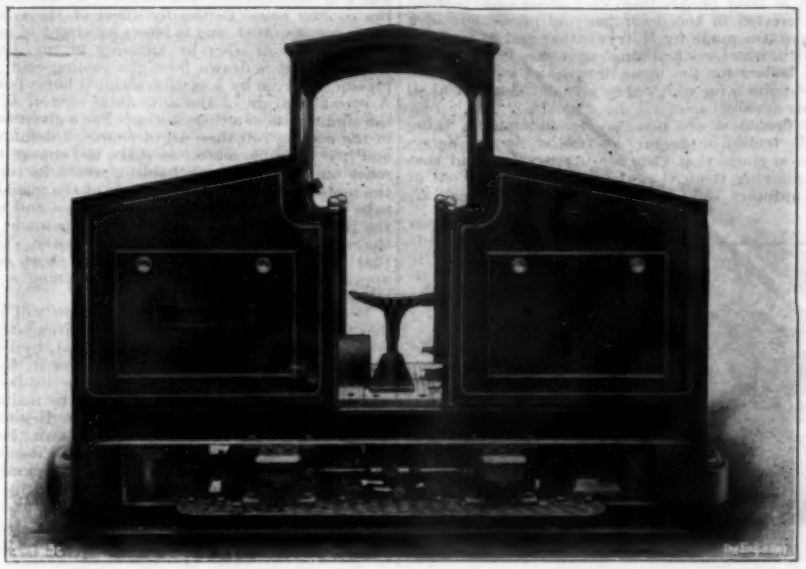


FIG. 20—5-TON, 2ft. GAUGE LOCOMOTIVE—CROSSLEY

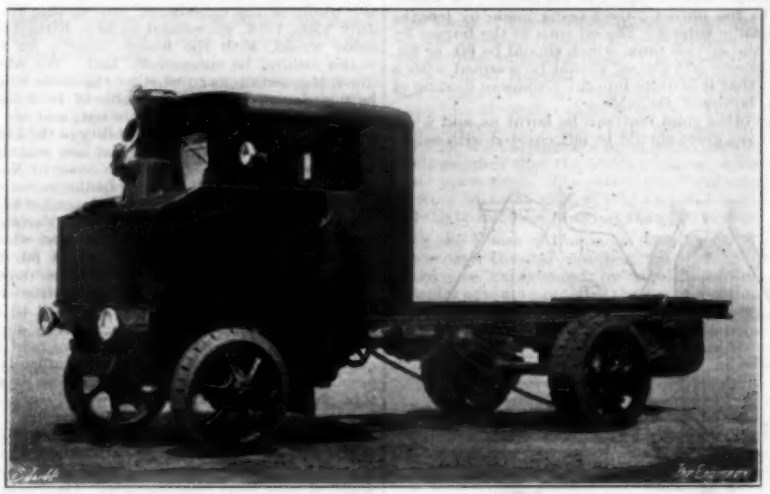


FIG. 21—6-TON STEAM WAGON—YORKSHIRE PATENT STEAM WAGON COMPANY

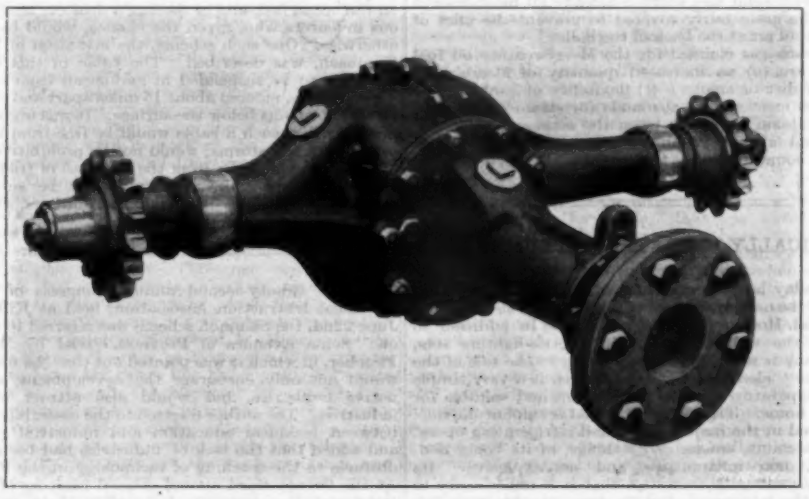


FIG. 22—TRANSMISSION GEAR CASING OF YORKSHIRE STEAM WAGON

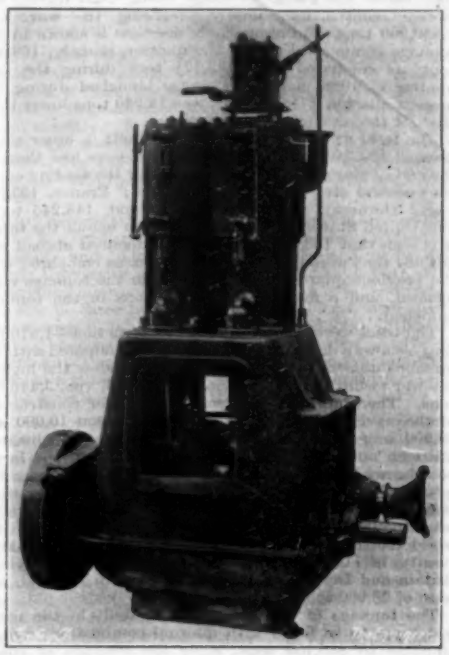


FIG. 23—ENGINE OF YORKSHIRE STEAM WAGON

The engine is of the vertical compound balanced type, 4½in. and 7½in. bore by 8in. stroke, and it develops 60 brake horse-power at 450 revolutions per minute. It is fitted with piston valves which are actuated by Joy radial valve gear. A radical alteration has been made in the lubrication system of the engine, which is of the dry sump variety, to prevent emulsification of the oil and get rid of the water of condensation. The arrangement comprises a pump which delivers oil into trays situated beneath the big ends, to ensure an ample supply of oil on all gradients. The oil is splashed up by means of dippers on the connecting-rod ends. The crank shaft is a machined solid steel stamping, and is fitted at the front end outside the casing with a fly-wheel to give steadiness of running. There is a large balance weight between the cranks, and all the bearings are of die-cast white metal. The two-speed gear is integral with the engine casing, and its heat-treated cut steel wheels are in constant mesh, being changed by a sliding dog clutch on the intermediate shaft in the crank casing. The drive from the engine is always through the intermediate shaft, being taken from it to the countershaft through a flexible joint. By the movement of a lever the engine can be temporarily converted into a double high-pressure engine, for which purpose there is a pipe from the boiler to the low-pressure cylinder.

Reverting to the lubrication system, it should be mentioned that any excess of oil thrown up by the dippers finds its way into a gallery in the form of a separate aluminium casting, from which the oil is led into four pockets above the bearings of the crank shaft, and countershaft. The oil is passed through a filter which can be withdrawn without dropping the sump.

The intercasing, situated behind the engine, with which it is connected by a flexible fabric joint, contains a novel form of differential which has no cage. The main pinions are solid with their shafts, whilst the planet pinions are carried by a spider. Both sets of wheels are of chrome vanadium steel. Neither ball nor roller bearings are employed in this transmission system. The oil grooves in the shaft bushes are arranged to return the oil to the centre from which it is thrown into reservoirs above the inner bearings. The axle thrust washers are of steel and bronze. The whole casing can be quickly removed from the chassis when necessary, and the gears can be easily dismantled. The final drive to the road wheels is taken by two roller chains.

The rear axle is of the dead type, and the road wheels, which are of cast steel, have tubular spokes and run in floating bronze bushes. Large brake drums are fitted side by side on each wheel. The springs are of great length and the thrust of the drive is taken through the Woodhead divided top leaf, so as to dispense with radius rods; means of adjustment to take up the stretch of the chains is provided at the

then further developments have been made with the starting arrangements.

We witnessed the starting of a 20 horse-power vertical two-stroke engine at the show, by means of the heat of compression acting upon a "burner" composed of some chemical ingredients inserted in the cylinder, which in turn ignited the gaseous charge.

front end of the springs. The front axle is a drop forging of 40 tons mild steel, and the road wheels are centrally pivoted. Ackermann steering with a steering column totally enclosing the spindle and nut are features of note.

The chassis frame is built up of rolled steel channels with strong cross stays. The cab is both comfortable and roomy, and full protection against the weather is provided for the driver, while the controls are all within easy reach. Access is given by two doors, one on either side. The capacity of the water tank is 190 gallons, sufficient for an average run of 35 to 45 miles, and the fuel bunker has a capacity of 8 cwt. of coal. The single rubber tires on the front wheels are 720 mm. by 160 mm., and the twin tires on the rear wheels 850 mm. by 160 mm.

In referring to the cold-starting heavy oil engines of Ruston and Hornsby, Ltd., of Lincoln, the fuel consumption was, by a typographical error, given as not exceeding 48 lb. per brake horse-power per hour. The figure should, of course, have been 0·48 lb.

The Quarter's Shipbuilding.

LLOYD'S REGISTER shipbuilding returns for the quarter ending June 30th, which have just been issued, show that the tonnage under construction in Great Britain and Ireland—841,338 tons—was only 1732 tons less than at the end of March, 1926, but about 252,000 tons less than the tonnage being built twelve months ago. The tonnage on which work was suspended at the end of June, 1926, amounted to nearly 78,000 tons, which was about the same as at the end of June, 1925. The totals were the lowest recorded since September, 1909, and were 1,049,000 tons below the average tonnage being built during the twelve months immediately preceding the war, i.e., 1,890,000 tons. An appreciable decrease is shown in the tonnage commenced during the quarter, namely, 168,483 tons, as compared with 193,121 tons during the first quarter of 1926, and the tonnage launched during the present quarter, 171,725 tons, was 18,980 tons lower than that for the previous three months.

The total merchant tonnage being built in other countries—1,129,349 tons—is about 38,000 tons less than at the end of March, 1926. The figures for the leading countries abroad are:—Italy, 287,346 tons; France, 153,955 tons; Germany, 148,851 tons; Holland, 148,245 tons; and United States, 133,268 tons. From one of the tables it is seen that 163,233 tons were commenced abroad and 204,064 tons were launched, a decrease, as compared with the previous quarter, of 31,110 tons in the tonnage commenced, and a decrease of 65,804 tons in the tonnage launched.

The total world tonnage under construction—1,970,687 tons—shows a decrease of 39,519 tons as compared with the previous quarter, and is 1,475,871 tons below the highest pre-war record reached on June 30th, 1913, viz., 3,446,558 tons. There are at the present time under construction in the world, twenty-five vessels of between 10,000 and 20,000 tons each and ten of 20,000 tons and upwards. Thirteen out of the twenty-five and three of the larger vessels, are being built in Great Britain and Ireland. The returns show that there are at the present time forty-three steamers and motor ships, each of over 1000 tons, with a total tonnage of 261,218 tons, under construction in the world for the carriage of oil in bulk. Of these tankers, twenty, of 113,765 tons, are under construction in Great Britain and Ireland, ten, of 62,360 tons, in Holland, and four, of 26,900 tons, in Germany.

The tonnage of vessels now being built in the world which are to be fitted with internal combustion engines, amounts to 885,100 tons, while the tonnage of steam vessels under construction is 1,051,649 tons. The motor tonnage is thus 84¼ per cent. of the steam tonnage. The tonnage of motor ships being built at the end of June in Great Britain and Ireland, 293,544 tons, amounted to 53.8 per cent. of the steam tonnage under construction. In Denmark, Holland, Italy, Japan and Sweden, the motor tonnage under construction greatly exceeds the steam tonnage; the combined totals for these five countries being 129,380 tons of steamers and 426,241 tons of motor ships. The world figures include fifty-six motor ships, each of between 6000 and 10,000 tons; seven of between 10,000 and 15,000 tons; four of between 15,000 and 24,000 tons; and one of about 33,000 tons.

Another of the tables shows that the total horse-power of the engines being built or being installed on board vessels at the end of June, 1926, amounted to 1,552,550 horse-power, of which 635,538 horse-power are being built or were built in Great Britain and Ireland; 170,250 horse-power in Italy; 146,504 horse-power in France; 142,750 horse-power in Germany; 137,100 horse-power in the United States; and 320,408 horse-power in other countries. Excluding 130 engines of less than 500 horse-power each, the average horse-power of each set reaches 3569 horse-power; the average for reciprocating steam engines being 1727 horse-power, for oil engines 4259 horse-power, and for steam turbines 10,250 horse-power.

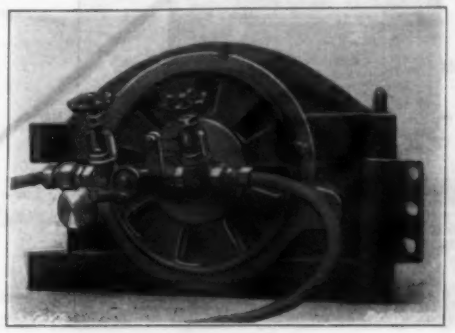
Of the vessels under construction in the world—which total excludes vessels the construction of which has not actually been commenced and also all vessels of less than 100 tons—297, of 1,391,033 tons, are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register Book.

THE new motor lifeboat which the Royal National Lifeboat Institution has stationed at Plymouth is a twin-screw lifeboat of the "Barnett" type, similar to the New Brighton boat on the Mersey. She has a length of 60ft., with a breadth of 15ft., and weighs 44 tons. Two 76 brake horse-power petrol engines give her a normal speed of 9½ knots, with a considerable reserve of power. At a cruising speed of 8 knots, the boat has a radius of action of 250 miles. Two other boats of a similar type are being constructed for the Stromness and Aberdeen stations.

Oil Fuel Apparatus for Steam Boilers.

USERS of steam boiler plant who are considering the conversion of their boilers from coal to oil fuel burning will be interested in the accompanying particulars of a simple apparatus made by Merryweather and Sons, Ltd., of Greenwich, who have had long experience in the manufacture of boilers for the horse-drawn and self-propelled steam fire-engines, for which they introduced a special oil fuel burning apparatus.

Oil fuel fire-doors are now, so we understand, being fitted to the boilers of several factories by Messrs. Merryweather, who claim that they are inexpensive, and that without removing them the boilers can still be fired at will with ordinary solid fuels. When the oil cocks are

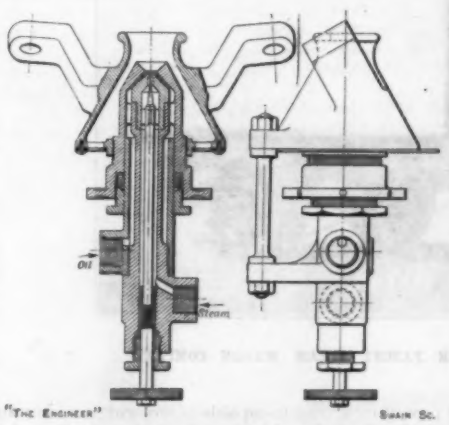


OIL FUEL FIRE-DOOR

closed the boiler is ready for solid fuel, and opening them reverts to oil fuel, the change over being instantaneous. There are no pressure pumps and no working parts liable to wear or get out of order.

The accompanying engravings illustrate the apparatus, and it will be observed from the drawing that it is necessary to provide a steam and oil supply to the burner, the actual connections to the burner valves being made by lengths of flexible metallic tubing. The oil runs to the burner by gravity from the service tank, which should be 6ft. or 8ft. above the burners, and the oil should be warmed with a steam coil, so that it is quite liquid. Excessive heating of the oil is not, however, desirable.

Coal or any other solid fuel can be burnt as and when required, and the grate should be left covered with ashes,



OIL BURNER

broken fire-brick or the like, so that when it is desired to carry on with solid fuel there is already an incandescent mass on the grate fairly covered to prevent the inlet of too much cold air at the back of the boiler.

The advantages claimed for the Merryweather oil fuel fire-doors are (*a*) an increased quantity of steam; (*b*) absence of dirt or smoke; (*c*) flexibility of control; (*d*) capacity to meet sudden demands for steam and ability to reduce steam promptly when the emergency demand ceases; and (*e*) economy in working which in some cases more than counterbalances the extra cost of fuel oil.

ELECTRICALLY OPERATED REFRIGERATORS.

ON Monday last we were invited to attend the formal opening of the new showrooms of the Delco Light Company, at Imperial House, Kingsway, W.C. 2. In addition to supplying the well-known Delco electric-lighting sets, the company is now devoting attention to the sale of the "Frigidaire" electric refrigerator, which is a very simple piece of apparatus, automatic in action and suitable for use in the home. The refrigerant used is sulphur-dioxide, as employed in the majority of small refrigerating operations on account, among other things, of its being non-poisonous, non-inflammable and non-explosive. Its primary advantage is, however, that it is unnecessary to replenish the refrigerant, for the pressures are very low and the gas is easily confined.

The Frigidaire apparatus works on the flooded principle of refrigeration. The flooding takes place in a cooling coil, which is filled with the refrigerant, and the amount in the coil is controlled by a float valve. As the refrigerant evaporates the float valve is lowered, thus permitting more liquid to enter the cooling coil to replace that carried away by evaporation. All parts of the coil are made of non-corrosive materials of high conductivity. No brine tank is employed, the heat passing direct to the coil itself. The condensing unit consists of a compressor, condensing coils, fan motor control gear and receiver. The copper condensing coils are mounted on both sides of the compressor. These copper tubes lead to a receiving chamber, which is connected in turn with the liquid line leading to the cooling coil. In the fly-wheel of the compressor a fan is incorporated, and it blows a current of air over the condensing coils, thereby assisting in the dispersion of the heat as it is drawn from the cooling coil. The compressor is driven by a small fractional horse-power motor. A special feature of the automatic control apparatus is the elimination of a thermostat. For a given temperature in the cooling coil there is, of course, a definite pressure, and it is a simple matter to make the change of pressure react on the control mechanism, which in turn controls the motor. From the suction side of the machine a small tube leads to a bellows, which collapses and expands as the pressure changes, and this action is made to actuate the switch which starts and stops the motor. The result is that the apparatus removes heat at short intervals of approximately 1½ hours, thus maintaining a very even temperature in the refrigerator.

It is expected that before long there will be a large demand for electrically-operated refrigerators in this country for this method of keeping food, by lowering the temperature to freezing point, or below it, by dry cold, presents marked advantage over the ice-box method, which can only keep the chamber cool by melting the ice. The impending new regulations of the Health Ministry, which will reduce the amount of preservatives the law now permits to be added to foods, must, it is considered, result in a great increase in the use of refrigerators.

SIXTY YEARS AGO.

SIXTY years ago the Great Eastern had started on her second, and, as it was to prove, her successful attempt to lay the Atlantic cable. She left the Medway with the cable on board on June 30th, and reached Bantry Bay on July 5th, 1866. The shore end had been laid previously by another vessel, the William Cory, and the delicate operation of splicing it to the deep-sea portion having been successfully accomplished, the Great Eastern set out for Newfoundland on July 13th. We had still to await the result of the expedition, but writing in our issue of July 13th, 1866, we seemed to have little doubt that the cable would, with the lessons taught by the previous year's failure, be successfully laid. We were, however, much less certain as to whether the cable when laid could be maintained intact. The cable of 1858 had had a life of only a month before it gave out, and we were apparently not optimistic as to the ability of the 1866 adventure to surpass that record. Our great fear was that the cable would be cut by icebergs off the coast of Newfoundland, for its course crossed the fishing banks, so we stated, at the exact point at which the icebergs grounded on their southward journey from the polar regions. Various authorities gave the depth of water at the point at which the cable was to cross the head of the bank at 60, 120 and 331 fathoms, and even the greatest of these depths, we said, was not sufficient to protect the cable from the attack of the icebergs, which frequently extended to 500 fathoms below the surface of the water. Even supposing that there was no danger from icebergs, we held that all past experience of deep-sea cables was completely against the possibility of their being maintained at work. No less than 9000 miles of such cables which worked when first laid had at the date of writing become "speechless." Less than 850 miles of deep-sea cable were at work, and of these cables only one, that between Sardinia and Sicily, represented an example of satisfactory working at a depth of more than 1000 fathoms. The Malta and Alexandria cable, on the example of which the promoters of the Atlantic cable greatly relied, was laid at the deepest in 420 fathoms, and on the average the interruptions to communication on it worked out at four days per 100 miles per annum. The experience of the past was certainly not very encouraging to the laying of a cable 2000 miles long at a depth exceeding 2400 fathoms in places. However pessimistic we might have been about the success of the cable, we commended the directors of the Atlantic Telegraph Company for adhering to the method of laying it on the ocean bed, and of turning a deaf ear to the numerous inventors who, given the chance, would have laid it otherwise. One such scheme, the invention of Mr. E. R. Kaulbach, was described. The cable in this inventor's plan was to be suspended in mid-ocean from cylindrical copper buoys, moored about 15 miles apart and submerged 10 to 15 fathoms below the surface. It was argued by the inventor that such a cable would be free from the effects of currents and storms, would not be prohibitively expensive, would not suffer from the presence of friction at the points of suspension, and would not be subjected to unpleasant attention from mussels, lobsters, sharks and whales.

AT the twenty-second annual Congress of the Irish Technical Instruction Association, held at Killarney, on June 22nd, the Shannon scheme was referred to in a paper on "Some Avenues of Progress," read by Mr. George Fletcher, in which it was pointed out that the undertaking would not only encourage the development of existing native industries, but would also attract many new industries. The author referred to the essential connection between technical education and industrial prosperity, and added that the lack of industries had been a serious obstacle to the teaching of technology in the Free State. At the twenty-third annual general meeting of the Cork Industrial Development Association, held in Cork on June 22nd, Senator J. C. Dowdall, moving the adoption of the annual report, referred to the Shannon scheme, and said: "The Shannon scheme will be sterile if industries of some sort are not in existence to utilise the energy it generates. Our efforts should be directed to establishing these industries in good time. Broadly speaking, the Irish Free State exports are raw material, people and cash, and the imports, manufactured goods."

Railway Matters.

OWING to coast erosion, the Walton-on-the-Naze branch of the London and North-Eastern Railway is being imperilled between that place and Frinton. A new line further inland is about to be constructed.

THE annual report of the National Union of Railwaymen shows that among its members there are 29 county councillors, 149 guardians of the poor, 219 rural councillors, 485 urban councillors, and 286 justices of the peace.

THE electrification of the Melbourne suburban railways has resulted in an increase in the passenger revenue of £325,000 a year. The passenger traffic at Flinders-street Station has increased by 63·4 per cent. since 1918.

ON Thursday morning of last week the down newspaper train from Liverpool-street to Norwich ran into a light engine at Brentwood. It is obvious that either the light engine was forgotten by the signalman or that the passenger train over-ran the signals.

IN the second tunnel at Colwall, on the Worcester-Hereford section of the Great Western, which is being built parallel with the existing single line tunnel, the track is, according to the *Great Western Railway Magazine*, being laid and the tunnel will be open for traffic very shortly.

THE Chancery Division is now engaged in hearing the application of a firm for an injunction to prevent the railway companies from increasing an exceptional rate. Actually, it is a test case to prove whether or not the companies have the power to increase their rates within the existing statutory limit and before the new scale of charges is operative.

THE Minister of Transport, answering a question on July 5th, said that the London and Home Counties Traffic Committee had reported upon the travelling facilities in North London, but he was awaiting its report on those in East London. As the questions were so inter-related, he thought the two reports should be considered together before any decision was taken.

THE omnibus station which is being provided for the London General Omnibus Company by the Southern Railway in the forecourt to the latter company's Victoria Station is to have a signal-box or control tower and a starting signal for each of the five loading platforms. The signals will be of the day colour light type, and will give yellow and green indications; the yellow will be shown when the time for an omnibus to start is approaching and green when it is time to start.

THERE is a probability of the long outstanding question of railway shopmen shortly being settled. It has been decided by the Industrial Court that these men are different from the regular engineering workmen, and the railway companies will not admit them to their conciliation schemes, as, many belonging to other crafts unions, there is no one truly to represent them. The difficulty with the other unions was the fear that the men would leave them and join the National Union of Railwaymen. By conference between the various societies, an agreement has been arrived at which will, it is expected, prevent desertions from a comparatively poor union to a better one, and also secure joint action.

A CORRESPONDENT—evidently a lover of horses—wrote to the *Manchester Guardian* lately on the subject of "The Return of the Horse," and pointed out that railway companies had been very conservative in discarding their horses. He said: "The returns recently published show that the four main line companies employed 18,266 horses in cartage work last year, a decrease of 296 only under 1924. They use 2261 motors—a fraction of the number of horses." To these figures let us add that the whole of the British railways had, at the end of 1925, 18,508 horses for road vehicles and 2282 motor vehicles for parcels and goods. For the previous four years, 1921 to 1924 inclusive, the totals of horses were 18,340, 17,912, 18,318, and 18,793 respectively; the corresponding figures for motor vehicles were 1690, 1947, 2099, and 2127. It may be that railway companies have been conservative in this matter, but in 1913 they had 26,270 horses and 191 motors. It is remarkable, however, that whilst there are 8000 fewer horses than twelve years ago, there are only 1000 fewer horse-drawn vehicles—31,662 as compared with 32,657.

THERE was issued on Saturday last the report of Colonel Sir John Pringle on the collision of May 10th—during the general strike—between a passenger train from Berwick to Edinburgh, London and North-Eastern Railway, and some wagons that were being shunted at St. Margaret, Edinburgh. Three passengers were killed. Two signal-boxes were concerned in the accident—St. Margaret's and Portobello West—which are about 1¼ miles apart, and both of which were in work at the time; the two intermediate boxes at Piershill Junction and Craigentinny were closed. Owing to the last-named having no switching out instrument block communication between the two outer boxes was broken, and reliance had to be placed on the telephone, which, in Sir John's opinion, was, with the diminished services, adequate for public safety in an emergency of that character. Three men contributed to the accident, but the inspecting officer makes every allowance for the disabilities under which they laboured. The blocking-back rule is not in operation on that section or the traffic inspector in charge of St. Margaret's box should have warned the man at Portobello West that he was about to block the down line by shunting. Despite the absence of the rule the inspector is considered to have been guilty of an error of judgment in not advising Portobello West of the condition of affairs. The latter man was at fault in not asking, over the telephone, acceptance by St. Margaret's of the passenger train, and the driver of the passenger train was to blame in not approaching St. Margaret's box prepared to stop, if need be, at the box, and for not obeying the red flag displayed there at an earlier moment. He ought also to have stopped when he saw soldiers and railwaymen waving their arms. The report recommends that under similar circumstances drivers should approach and pass signal-boxes at a low speed, say, 10 miles per hour, to ascertain whether the boxes are open, and that the blocking-back rule be operative when the line is about to be obstructed.

Notes and Memoranda.

PROSPECTING which has been carried out recently in the Vereen Richtersveld district, to the south of the Orange River in South Africa, have revealed a solid mass of native copper weighing between 1 and 2 tons.

IF built the proposed Montreal-Ottawa-Georgian Bay ship canal is proposed must be started on or before May 1st, 1927. It when deep, but will be 440 miles long by 200ft. wide and 25ft. 55 miles of dredged require 40 miles of real canal and most of the route channel, as natural waterways form 50,000,000 dollars. The capital of the company is

So many prospectors regions of Northern Ontario going into the new mining of Mines has issued a list of the Ontario Department required on such bush journeys articles and provisions the outfit for two men includes a canoe. For a month's trip, 80 lb. each. The provisions include and three packs of chief foods being flour, bacon and sixty-six items, the estimated to require 3 lb. of food a day, lasting about 1 dollar.

PAPER No. 22 of the Safety in Mines Research Board, which has just been published by H.M. Stationery Office, describes how an absolute method has been applied to the determination of the velocity of detonation over short lengths of explosive. The method depends on the partial discharge of a condenser through a known non-inductive resistance during the time that the detonation wave travels between two points at which the circuits are broken. Concordant results were obtained when the method was tested with mechanical arrangements which were known to give time intervals of the order 10^{-4} and 10^{-5} sec.

A DEVICE evolved by the Dutch inventor, Professor Enthoven, and adapted by his son for wireless telegraphic purposes, is the subject of some important experiments which are being conducted this week by the local telegraph authorities in connection with wireless communication to the Dutch East Indies. According to the *Handelsblad*, it is hoped that the new invention will reduce the effect of atmospheric disturbances to a minimum, thereby bringing about a considerable saving in time in wireless transmission. It is stated that, if anticipations are realised, it is hoped that it will be possible to do in one hour what now takes twelve hours.

THE Corporation for the Technical and Economic Development of the Sulphur Industry has signed a contract for the electrification of all the services connected with the Sicilian sulphur mines. The power will be produced by a central thermal electric station at Catania, which will transmit it to all the sulphur mining districts over a main line at 40,000 volts running between Catania, Caltanisetta, Campo-Franco, with a subsidiary line at 10,000 volts for the Caltanisetta-Sommatino district. The agreement requires that the whole installation be completed in three years time. The cost of the installation is estimated at from 34 to 35 million lire, and the total length of the lines to be installed is no less than 500 kiloms.

IN the House of Commons recently Mr. Day asked the Postmaster-General whether, in view of the oscillation annoyance experienced by wireless listeners, he would consider action to prohibit the use of reaction on the aerial. Viscount Wolmer said that on the recommendation of the Broadcasting Committee of 1923 a condition was inserted in all wireless receiving licences that "reaction must not be used to such an extent as to energise any neighbouring aerial." He did not think it would be in the general interest to prohibit entirely the use of reaction, which was of considerable advantage in increasing the sensitiveness of wireless sets and only caused interference when improperly used. Mr. Day asked if the Postmaster-General would see that the regulation was enforced, and Viscount Wolmer replied that the authorities were enforcing it very strictly.

A SHORT article in the *Chemical Trade Journal* describes the process employed in Saskatchewan for the production of sodium sulphate from the local alkaline lakes. The natural crystals are dissolved, and the solution is filtered. The clarified and heated brine is then pumped to the top of a tower and sprayed through special nozzles. Hot gases from oil burners are admitted at the bottom of the tower and dehydrated sodium sulphate in the form of a fine powder is collected at the base of the tower. Two forms of salt cake are produced. The first, a white fluffy powder, containing less than ½ per cent. of moisture, and weighing approximately 30 lb. per cubic foot, is obtained directly from the drying tower. The second product, a nodulised sodium sulphate, weighing 90 lb. per cubic foot, is produced by partial spray drying followed by fusion in a rotary drier. It is estimated that there is a reserve in excess of 100,000,000 tons available for commercial development.

PRACTICAL suggestions for the abatement of the coal smoke nuisance in Leeds are contained in a booklet, entitled "Clean Air for Leeds," that was distributed free during the week of celebrations, which began on Friday last, of the tercentenary of the granting of a charter to the city. The Committee advocates:—For private houses, hotels, and institutions, cooking by gas or electricity, water heating by coke, supplemented for occasional use by gas or electricity, and, for general heating, where central heating is used, coke boilers, and where fireplaces are used, the substitution, as far as practicable, of coal by coke; for factories, precautions, if necessary under legal pressure, for the prevention of excessive smoke by:—(*a*) Effective installation and suitable appliances; (*b*) the use of proper care on the part of the firemen that the apparatus is employed to the best advantage. Generally, the Committee recommends that public opinion be directed to the matter so that the community may appreciate that a great improvement can be made and that such an improvement will do much to remove one of the worst evils of modern English city life. The Committee expresses the belief that with a little effort and good will on the part of the citizen in adopting its recommendations, and enhanced facilities by the provision of cheap smokeless fuel, combined with a firmer attitude towards defaulters on the part of the local authority, smoke in Leeds, if not entirely suppressed, might be reduced to an almost insignificant amount.

Miscellanea.

A SEAM of coal, about 24ft. below the surface, has been located in a field at Woodville, near Burton-on-Trent.

IT is reported that the Government has decided to adopt the report of the Committee on Broadcasting, and will, on the expiry of the present British Broadcasting Company's licence on December 31st, take control of British broadcasting.

THE output of coal from the mines of the Pekin Syndicate during 1925 amounted to 611,397 tons, as compared with 655,858 tons for the previous year. The reduction was due to the shortage of wagons, caused by the railways being occupied by the military.

A SCHEME for the manufacture of electrical insulators in Bihar, India, with the china clay resources found in the province, is being considered by the provincial Board of Industries. It is estimated that a sum of about Rs. 5 lakhs will be required to work the scheme.

DURING 1925 the United States imported 899,569 thousands of hand sewing and darning needles, valued at 1,039,815 dollars and 228,591 dollars worth of other sorts of needles, exclusive of phonograph needles. The hand sewing needles came mostly from the United Kingdom (482,284 thousands, valued at 778,036 dollars).

THE Norwegian mercantile fleet at the half-year amounted to 2,774,000 tons gross. During the last six months motor vessels increased by 90,000 tons and steamers by 7000 tons. There were sold abroad about 55,000 tons, corresponding approximately to second-hand tonnage bought abroad. There are now 125,000 tons under construction.

WORK is to be started very shortly on a hydro-power development at Alexander's Landing, near Cameron Falls for the Ontario Hydro-electric Power Commission. Six units giving a total output of 75,000 horse-power will be installed. Alexander's Landing is 1 mile below Hydro, being 12 miles upstream from Nipigon. The level of Lake Nipigon is to be raised 4ft. by a dam, and then 150,000 horse-power will be available from the Nipigon.

DECREASES both in the number of factories for the manufacture of explosives and the number of persons employed in them, are recorded in the annual report of his Majesty's Inspectors of Explosives for 1925, which was issued recently. The factories totalled 104 and the workpeople 9610, compared with 133 factories and 13,103 people in 1920. The 1925 figures are the lowest recorded for the factories, while the only lower total for workpeople is that of 1885.

SIMULTANEOUSLY with the offer of research scholarships by the Rockefeller Institute, the Commonwealth Institute of Science and Industry has offered scholarships to Melbourne University men of the value of £300 a year, with a travelling allowance of £150. Research is to be directed into one of three purposes:—Food problems, principally cold storage; liquid fuel; forest products. Students availing themselves of this offer are expected to give an undertaking to serve the Institute for three years on their return at a minimum salary of £400 for the first year, £450 for the second, and £500 for the third.

IN view of the enormous amount of scientific and other special information now available in periodicals and libraries, an association—the Association of Special Libraries and Information Bureaux—was formed to assist in making such information available to all who wish to use it. With the assistance of the Carnegie United Kingdom Trust, the Association has undertaken, as one of its first activities, the compilation of a directory of sources of specialised information in Great Britain and Ireland. The general editorship of this work has been entrusted to Mr. G. F. Barwick, formerly Keeper of Printed Books at the British Museum.

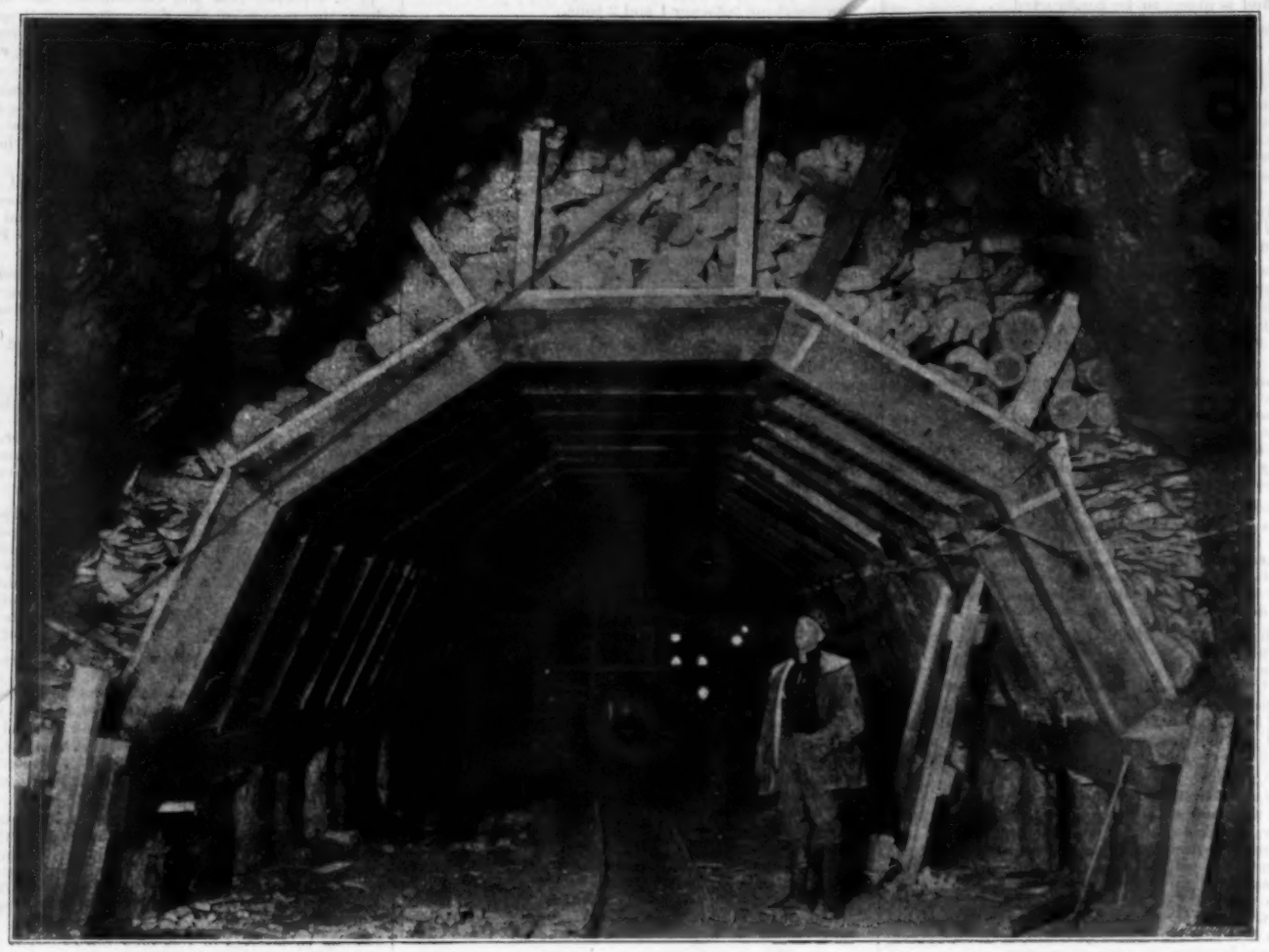
THE Irish Free State Department of Agriculture is endeavouring to stimulate the interest of agriculturists and fertiliser manufacturers in the phosphate deposits of County Clare. It is stated in the *Chemical Trade Journal*, that these deposits, which contain up to 70 per cent. of total phosphates, and are found between Kilfenora and Ballyvaughan, are in sufficient quantity to supply the total needs of the British Isles. Extensive field trials are being made this year, both with the ground phosphate and with superphosphate manufactured from it. It is understood that modern machinery for winning and preparing the rock is to be imported from England by those interested in the mineral rights.

THE Union Minière—the Katanga Copper Company, Congo—is concentrating all its efforts at Panda, where the big lixiviation plant is ultimately to produce 90,000 tons of electrolytic copper annually. The central power plant of 10,000 kilowatts is to be trebled. An ore-reducing plant is also under construction there, comprising three reverberatory furnaces which will produce 30,000 to 40,000 tons of copper yearly. The first furnace will be lighted during the second half of this year. In addition, a third works, to treat ore by flotation, is to be erected in the neighbourhood. As a result of these measures, it is anticipated that production will be lifted to 200,000 tons within two years and a-half, if labour difficulties are settled.

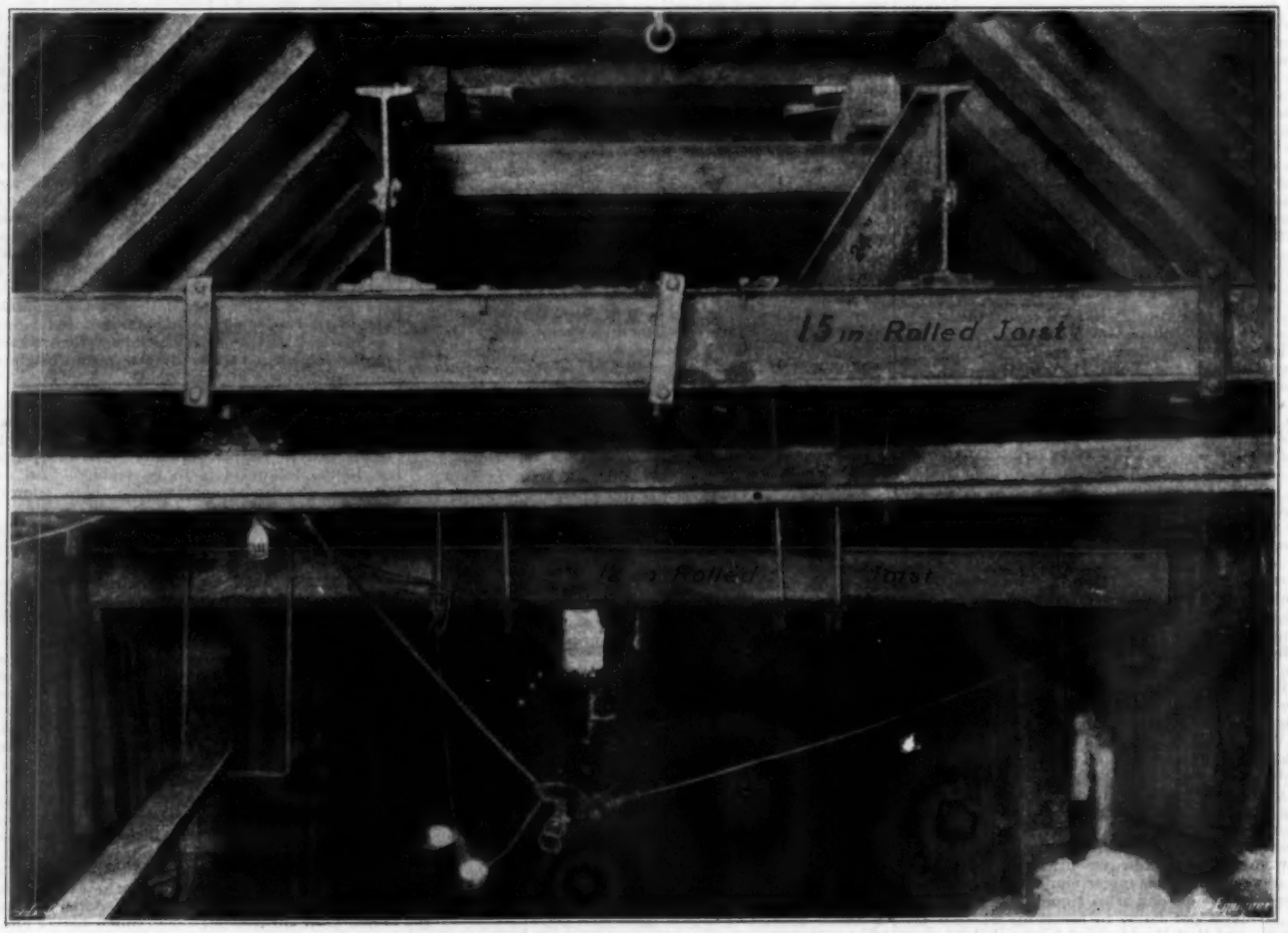
THE part played by electric lighting on the tube railways is now so widely appreciated that the continual small changes and improvements are apt to escape notice. In connection with some of the new escalator systems, much has been done, and there is general evidence of the tendency to eliminate glare in every possible way. The lighting of subways offers something of a problem, in view of the sudden change in brightness as a passenger emerges into the bright illumination outside; something might perhaps be done to alleviate the contrast by exceptionally powerful lighting near the exits. Incidentally, one has an opportunity of observing, in certain subways near Liverpool-street, the comparative merits of bare lamps and shaded units. On a considerable length of the subways, bare lamps are still installed, but in part well-shaded lamps have been substituted. The much better effect of these, as one looks down the long passage and compares them with the bare lamps, is quite evident.

THE MOFFAT TUNNEL NEAR DENVER, COL., U.S.A.

(For description see page 54)



FIVE-SEGMENT ROOF ARCH



STEEL BEAMS CARRYING ROOF TIMBERING

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 576, Cangallo.

CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.

EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.

FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris. CHAPELOT AND CIE., 136, Bld. St. Germain, Paris.

BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

INDIA.—A. I. COMBRIDGE AND CO., Bombay; THACKER AND CO., Limited, Bombay; THACKER, SPINK AND CO., Calcutta.

ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umberto I, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.

JAPAN.—MARUZEN CO., Tokyo and Yokohama.

AFRICA.—WM. DAWSON AND SONS, Limited, 7, Sea-street (Box 49), Capetown.
C. JUTA AND CO., Johannesburg, East London, and Grahamstown.

AUSTRALIA.—GORDON AND GOTCH, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
MELVILLE AND MULLEN, Melbourne.
ATKINSON AND CO., Gresham-street, Adelaide.

CANADA.—DAWSON, WM., AND SONS, Limited, 87, Queen-street East, Toronto.
GORDON AND GOTCH, Limited, 132, Bay-street, Toronto.
MONTREAL NEWS CO., 386-388, St. James-street, Montreal.
TORONTO NEWS CO., 42, Yonge-street, Toronto.

CEYLON.—WIJAYARTNA AND CO., Colombo.

JAMAICA.—EDUCATIONAL SUPPLY CO., Kingston.

NEW ZEALAND.—GORDON AND GOTCH, Limited, Wellington and Christchurch; UPTON AND CO., Auckland; J. WILSON CRAIG AND CO., Napier.

STRAITS SETTLEMENTS.—KELLY AND WALSH, Limited, Singapore.

UNITED STATES OF AMERICA.—INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York; SUBSCRIPTION NEWS CO., Chicago.

SUBSCRIPTIONS.

THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive THE ENGINEER weekly and post free. Subscriptions sent by Post Office Order must be made payable to THE ENGINEER and accompanied by letter of advice to the Publisher.

THIN PAPER COPIES.		THICK PAPER COPIES.	
Half-yearly ..	£1 11s. 6d.	Half-yearly	£1 13s. 9d.
Yearly	£3 3s. 0d.	Yearly	£3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition .. £3 3s. 0d. ,,

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

ADVERTISEMENTS.

*** The Charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "THE ENGINEER DIRECTORY," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

"THE METALLURGIST"—BINDING CASES.

Cloth Binding Cases for twelve issues (one year) .. .. 2s. 0d.
Subscribers' own copies, including cases, bound Cloth .. 4s. 0d.
Bound half roan 7s. 6d.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, July 16th, 1926.

	PAGE
A SEVEN-DAY JOURNAL	55
THE MOFFAT RAILWAY TUNNEL, U.S.A. No. III. (Illus.)	54
PRODUCTION AND THE PRODUCTION ENGINEER. No. II.	56
INLAND NAVIGATION AND WATER POWER EXHIBITION AT BASLE	57
ROYAL AGRICULTURAL SHOW AT READING. No. II. (Illus.)	58
THE QUARTER'S SHIPBUILDING	62
OIL FUEL APPARATUS FOR STEAM BOILERS. (Illus.)	62
ELECTRICALLY-OPERATED REFRIGERATORS	62
SIXTY YEARS AGO	62
RAILWAY MATTERS	63
NOTES AND MEMORANDA	63
MISCELLANEA	63
LEADING ARTICLES—	
Man and Machines	65
The Legibility of Power Station Instruments	66
BOOKS RECEIVED	66
THE TIMBERING OF TRENCHES, SHAFTS AND TUNNELS. No. I. (Illus.)	67
NEW COAL HANDLING PLANT AT BECKTON. (Illus.)	69
OBITUARY—	
James Thomas	71
A NEW PHASE ADVANCER. (Illus.)	71
THE LEEDS TERCENTENARY	71
SOUTH AFRICAN ENGINEERING NOTES	72
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	73
Lancashire	73
Sheffield	74
North of England	74
Scotland	75
Wales and Adjoining Counties	75
LAUNCHES AND TRIAL TRIPS	75
CURRENT PRICES FOR METALS AND FUELS	76
FRENCH ENGINEERING NOTES	77
BRITISH PATENT SPECIFICATIONS. (Illus.)	77
FORTHCOMING ENGAGEMENTS	78
PERSONAL AND BUSINESS ANNOUNCEMENTS	78
CONTRACTS	78

DEATH.

JULY 4th, suddenly, in his sleep, Mr. C. S. GILMAN, chairman of Allen-Liversidge, Ltd., of Victoria Station House, Westminster, S.W. 1.

THE ENGINEER.

JULY 16, 1926.

Man and Machines.

THERE is no subject under the sun that is more sodden with platitudes than industrial economics. Read the many books that have been written on it, listen to speeches and sermons, peruse the letters in the Press and the articles by leader writers and Special Labour Representatives or Commissioners, and you cannot fail, after a time, to find that one and all of the authors are galloping after one another in a never-ending circle like the signs of the Zodiac. Each has his own characteristics. One is a philosopher and holds the scales, another is Leo and roars nationally, Labour puts its head down and butts "at large" like a bull in a china shop, the simplicity of another is virginal, another crab-like moves in devious ways, and yet another is an offence to the nostrils of all. Round and round they go in the everlasting circle, never widening it, never narrowing it, never changing its speed, never altering their relative positions to each other. And the cacophony deafens us; the Bull bellows his trades-union doctrines, the Lion roars the national necessity of export trade, the balance implores you to concentrate upon the economic facts, the Virgin babbles sentimentally, Scorpio shoots vitriolic nonsense, and the nihilistic Crab crawls noisily sideways with clatter of claws. And it all leads nowhere. We make agreements and swear brotherly love with our tongues in our cheeks, we produce scraps of paper and tear them up at convenience, we study the success of others and bring home slogans of progress from foreign lands; we pray, we beseech, we threaten, we vote, we constrain, but all comes to nothing. At the back of it all there is no real understanding of the condition in which we are, and the whirling Zodiac has no notion of its course through space, no Einstein to tell it whether it is moving or standing still, no pilot to direct its course.

Thus the industrial world goes on buffeted by troubles. It is curious that in America, surely the most industry-saturated nation of the globe, the first glimmering of something different from the familiar platitudes should be seen. Yet such is the case. American is, we know, a very sentimental nation—do not her "films" proclaim it?—and sometimes it is justifiable to put her high thoughts down to no higher emotion. But when all fair deductions are made the fact remains that American philosophers, American authors, even American industrialists, do really seem to be striving to see a little bit further than other people through the brick wall of platitudes which hems in the study of industry. All of us are subject to that peculiar feeling of uneasiness that comes over us when things are going exceptionally well, and it may be that the attitude of American thinkers at the present day is no more than a reflection of that feeling. Yet, on the whole, we are inclined to believe that there is more in it than that, and that they are really trying to map out the course of the industrial and even of the scientific world, and to reach some estimate of what the future holds for mankind. A very notable example of this thinking outside the circle is presented by "Ouroboros," a little book recently published by Kegan, Paul, Trench, Trubner and Co., Ltd. The author is Garet Garrett, an American who has written a novel or two, but who appears to be an economist. Ouroboros is the name of the serpent which swallows its own tail. It is a fitting title for a book which sets out to show how machines and industrial processes have involved man in a tragic circle. Let it not be supposed that we have here Butler in a new guise. Butler perhaps foresaw prophetically what Garet Garrett is witnessing in the flesh, but there the similarity ends. In "Erewhon" they cast their machines away because they feared their effects; in "Ouroboros" we have a picture, painted in economic colours, of a world moving towards the culmination which the Erewhonians feared and avoided. The machines have taken charge. They must be constantly fed at an ever-increasing pace. There must be a vast output or no output at all; the medium output is uneconomical. Hence, already "the divisible product of artificial things tends to exceed the sum of human desires" and "we get a series of complex phenomena of which there is nowhere yet a complete understanding." It is, in fact, the necessity to sell which is upsetting the world. "How to produce enough is no longer any problem at all. How to sell what is produced—that is the problem." New ways of wanting, new customs of having, have to be created; the ways of contented unsophisticated peoples have to be changed. "They must be brought forward, modernised, electrified, taught how to want more. Why? In order that they shall be able to consume their quota of the machine's divisible product. Plenty shall be put upon them" for "the machine that was to have been a labour-saving device is become an engine of production that must be served." Here you have briefly the text upon which Garet Garrett enlarges with astonishing skill. Many of us, no doubt, have seen the same thing dimly; he makes it as plain as daylight. How many of us had clearly understood that the machine is responsible for that lack of thrift which we deplore. In America sales on the instalment plan have reached dangerous proportions. Motor cars, player-pianos, gramophones, books, radio sets, and so on *ad lib.* are sold by the thousands and tens of thousands to people who cannot afford them. Why? To satisfy the mass production factory. The salesman forces them upon the public. The good citizen is he who buys. "To consume—to consume more and more progressively—to be able to say in the evening 'I have consumed more to-day than I consumed yesterday,' this now is the duty the individual owes to industrial society." If they ceased to buy disaster would follow. Industry would be depressed, machines would stop, millions would be unemployed, and bankruptcy would be rife. The machine, it will be seen, is the insatiable dragon of industrial romance. We must not stay to follow Ouroboros in the ceaseless gyration after his own tail. We must skip many of Garet Garrett's fascinating pages in which the effect of the power of the machine upon the whole world is described and turn to the end to see if the ever accelerating whirling can be stopped and man's subjection to the machine be arrested. Here our author himself, whose lucidity hitherto has astonished us, can see but dimly. He is convinced that there is a way out, that we may still go on using machines and yet be masters of them, but he can only make vague suggestions where the road lies. A new conception of commerce amongst nations is what the world wants, a conception that would destroy the predatory instincts of the conquest of markets, and allot industries amongst those best fitted to conduct them. But we are as yet far, far from that, and much tribulation must be passed through before it is attained. "The probability is that he (man) will find the way unknowingly, by groping, and will be well upon it before he has had time to formulate any clear idea or theory of what he is doing. He will have found little by little that it pays better than any other

way, not as he once understood profit, but in terms of enduring satisfactions, which may include peace. Critical understanding of it will come later with reflection, and as it comes he will rid his mind of the phantasy in pursuit of which he has made the world so much richer in things than in happiness. . . . . In any light, man's further task is Jovian. That is to learn how best to live with these powerful creatures of his mind, how to give their fecundity a law and their functions a rhythm, how not to employ them in error against himself—since he cannot live without them."

Thus our author ends in a vision of hope. But it is hope long deferred, for the truth is that his analysis is full of forebodings. There is something tragical in it. The *Deus ex machina* which we had imagined to be a beneficent creature is shown in a new light—a devouring god. The worst of it all is that Garet Garrett's arguments can hardly be contested. They are drawn from common experience and fit in with it. We know the laws that make mass production economical, we know that nations after nations that used to buy from us are now making for themselves, we know that as they become more and more industrial they will have less and less food to sell; we know, speaking now of our own country, that as time goes on we shall have to give more and more of our products for a bushel of wheat. All these are facts which cannot be questioned, facts which are familiar enough, but of which the final meaning had escaped us. In "Ouroboros" the conclusions are laid stark before us. It is very well that they should be. We have before now pleaded that the facts of economics should be looked upon with detachment and that the readiness to see personal bias in them should be kept under control. Garet Garrett shows us the machines making the great essential facts—not man at all. It will help us perhaps to bear with patience the difficulties that we have to face when we know that they are not of our own making, but it will not help us much towards a solution of them. Yet there is some glimmering of light to lead us in a safe direction. As a little nation we are, if our author is correct, in a parlous way, but as a unit in a vast empire we might look upon the future without fear. Could we but make with all the other units of the Empire what Garet Garrett would call a symbiological contract to help each other's most favourable industries, then once more we should gain command of our machines and find in them our confederates rather than our masters.

The Legibility of Power Station Instruments.

IT is now fully recognised that the efficient operation of a power station requires a far greater number and variety of instruments than were considered necessary a few years ago. Modern systems of control are impossible unless temperatures, steam and water flows, draught, CO_2 percentages, &c., are indicated or recorded at many points, and it is now realised that the readings to be taken in the boiler-house and engine-room are quite as important as those taken on the switchboard. Instrument makers have not been backward in responding to the demands of the engineer for measuring apparatus of various kinds, but those makers who have a practical knowledge of power station conditions, or sufficient imagination to visualise them, seem to be in a small minority. The consequence is that a great amount of ingenuity and money are wasted in producing very ineffective and troublesome apparatus. One of the commonest faults of an otherwise good instrument, and a fault which is as inexcusable as it is common, is want of legibility. The whole object of an instrument is to show something, and in so far as this requirement is not adequately met, the instrument is a bad one, no matter how perfect or wonderful the works inside the case may be. In a power station the instrument is often required to tell its tale in a dim light at a distance of several yards, and its reading should be obvious to the hastiest of glances. The conditions are very different from those of a laboratory, where an observer can sit down in front of an indicator and study the face at short range. A scale which seems beautifully clear to such an observer, or to the draughtsman who designed it as he leans over it on a drawing board, may be hopelessly inadequate in an engine-room or boiler-house. It is not as though proper legibility cannot be combined with all the accuracy necessary, or even useful in power station work. Everyone can see the engine-room clock and nobody would change its honest legible face for that of a split seconds chronograph on the grounds that the latter may be more accurate. For tests and other special purposes the chronograph may be preferable to the clock, but special purposes naturally call for special instruments, which are not necessarily those most suitable for the ordinary routine operation of the station. The instruments which are wanted for the latter duty need have no greater accuracy than is attainable in the fundamental measurements of coal, water, calorific value and electrical output, but they must be robust and reliable, with clear and unmistakeable readings.

If anyone were to take a number of power station instruments designed by different makers for the same duty and determine by experiment the distances at which the respective readings ceased to be legible, he would be considerably astonished at the results obtained. The difference in many cases is extraordinary. Some makers seem almost ashamed that their instrument should be looked at at all, and they make the scale and figures so small and use a pointer so thin and so much hidden by the instrument casing, that the task of reading is not for him who runs. There is a further test which is equally instructive, namely, to note the range of angular position through which reading is possible. In a laboratory the observer can usually so place himself or the instrument that he is directly in front of it when taking readings, but in a power station the indications of an instrument ought to be legible to anyone looking at it from a position a reasonable distance to one side, above or below the ideal observation point. A comparison of instruments in respect of the two features referred to would bring home to some of the makers how far their products fall short of what can be, and ought to be, obtained in the way of legibility. It might also do good by causing them to study the conditions upon which legibility depends. Leaving out of consideration mercury or other fluid gauges, all indicating instruments embody a pointer moving over a scale. The pointer may be pivoted centrally with a scale extending nearly round the circumference, as in the ordinary pressure gauge; it may be pivoted excentrically, as in many voltmeters and ammeters; the whole instrument may be sector-shaped, as the ordinary "station type" voltmeter, or the edgewise principle may be adopted. The latter is always the least legible. This is not only on account of the curvature of the scale. The principal reason is because all that can be seen of the pointer is its head, and that is not enough. When a man looks at a clock all he really regards is the position of the hands. He pays so little regard to the figures that as a rule if asked a moment afterwards he could hardly be sure whether they were in Roman or Arabic characters. He can, in fact, tell the time almost as well if there are no figures at all. The same reasoning applies to instruments other than clocks. The observer very soon knows the scale sufficiently well to be able practically to disregard it, and to read the instrument by a glance at the position of the pointer. We recently noticed two CO_2 instruments of the electric type working in the same boiler-room. One of them had an edgewise scale with only the head of the pointer showing, and the other a quadrantal scale over which worked a pointer 4¼in. in length, of which the whole was visible. There was no comparison between the legibility of the two instruments, and future orders from that station will go to the makers of the latter kind on the ground of legibility alone.

The wanton sacrifice of legibility, with no compensating advantage whatever, is often to be seen in instruments of the quadrant type, in which the scale is seen through a window in the iron casing of the instrument. There are makers who make the window so narrow that only the head of the pointer is visible, when they might just as well have allowed an inch or two more of it to be seen through the glass, with enormous benefit to legibility at a distance. Furthermore, in some of these instruments the pointer and scale are so far behind the instrument front, that the ironwork of the latter hides much of the pointer, which might otherwise have been visible, when the instrument is mounted above the level of the observer's head. Instruments of this type very often are so mounted, and in that case, if they are of such a design that they cannot be tipped forward as a whole, they might be much improved by having the scale and the pointer end set over at an angle to give greater visibility. Many other points might be raised with regard to certain instruments on the market, but our object is rather to induce makers to pay more attention to the general question of legibility than to hold up any particular design to censure. The design of scales with their figures and subdivisions is worth detailed study. It has long been recognised by typographers that certain styles of printed letters are more legible than others of equal size, and a similar fact has been found with regard to figures. Errors of misreading, for example, are said to be less frequent with some tables of logarithms than with others, and this is attributed entirely to the style of figures adopted. A similar superiority is no doubt to be found in certain types of instrument scales. The number, size and style of the figures to be inscribed on the scale, the height, width and spacing of the graduation and sub-graduation marks, the presence or absence of border lines along the row of graduation marks, are all matters which are worth close consideration. If one looks at an ordinary steel rule, and notices the relative heights of the graduations denoting thirty-seconds, sixteenths, eighths, quarters and halves, and the spacing of the horizontal lines which correlate the various subdivisions, he will see that considerable art is required to make a good-looking and easily legible scale. The rule maker, like the clock maker, has, however, not only a long experience of what is essential to legibility, but he has also comparatively little scope for originality. All his inches are the same length, and his subdivisions are standardised. Moreover, a steel rule is always used at about the same distance from the eyes. The instrument maker, on the other hand, has a very great variety of requirements to meet. The scales he has to construct are of many kinds, and have frequently to be unequally divided. The same principles, however, apply to all, and all will be judged by the facility with which the eye can grasp the magnitude of the quantity which the instrument is measuring. If the quantity is worth measuring at all, the reading might at least be shown clearly on a sensible and good-looking dial. The face of an instrument may be either its fortune or its misfortune, and many an otherwise good meter arouses a sentiment varying from a vague dissatisfaction to a positive dislike on the part of the power station engineer merely because of the impossibility of seeing from a reasonable distance what it is indicating. When this occurs, nobody is to blame but the instrument maker. Since no type of instrument scale can be called bad except by an implicit comparison with one that is better, our condemnation of ineffective scales is also a commendation of those in which the principles of legibility have been observed. It would seem to be unquestionable that instruments in which the whole of the pointer is visible are those most easily read, and that intrinsic legibility probably reaches its minimum value in edgewise types with convex scales and nothing but the head of the pointer showing. The best instrument for the laboratory is not necessarily, or even generally, the best for the power house and it is a want of appreciation of power house, conditions that hampers the efforts of so many makers. A study of instrument faces and their comparative legibility from various distances and at various angles would, as we have said, give some surprising results, and would teach lessons which might be taken to heart by makers, with benefit to themselves and to their clients.

BOOKS RECEIVED.

Commercial Art. Number 1. Volume I. (New series). London: *Commercial Art*, 44, Leicester-square, W.C. 2. Price 1s. net.

Annual Report of the City Engineer of the City of Providence, 1925. Providence: The City Engineer, Rhode Island, U.S.A.

Science and the Modern World. By A. N. Whitehead. London: The Cambridge University Press, Fetter-lane, E.C. 4. Price 12s. 6d. net.

Wassermessungen bei Wasserkraftanlagen. By Dr.-Ing. L. A. Ott. Munich: Richard Pflaum Verlag A.G., Herrnstrasse 10, Germany.

Cement Concrete and Bricks. Second edition. By A. B. Searle. London: Constable and Co., Ltd., 10, Orange-street, W.C. 2. Price 24s. net.

Transport Aviation. By A. Black. London: The Siemens-Boardman Publishing Company, 34, Victoria-street, S.W. 1. Price 12s. 6d. net.

Public Works Department Administration Report. Part II., *Irrigation*, 1924–1925. Madras: The Superintendent, Government Press, India. Price Rs. 3-8-0.

The Metallography of Steel and Cast Iron. By W. E. Woodward. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. Price 15s. net.

Railroad Construction: Theory and Practice. Eighth edition. By Walter Loring Webb. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

Report of the Proceedings of the Second Conference of the Association of Special Libraries and Information Bureaux. London: The Association of Special Libraries and Information Bureaux, 38, Bloomsbury-square, W.C. 1. Price 5s. net.

The Timbering of Trenches, Shafts and Tunnels.

By C. G. KENT, A.M. Inst. C.E.

No. I.

THE object of the present articles is to describe in detail the timbering of excavations, the limiting dimensions of which are those required for the construction of sewers of the largest size—*i.e.*, up to about 18ft. external diameter—and the description of which is consequently applicable to many other kinds of engineering work. The methods of fixing timbering and practical considerations connected with the subject, which apply to excavations of all dimensions will be dealt with as fully as possible.

While the timbering of excavations obviously has for its primary objects the holding up of the ground, thus rendering possible the construction of the work in hand and ensuring the safety of the men engaged upon it, it is essential, in addition, that every care should be taken to avoid disturbance of the ground for the following reasons:—First, to obviate the possibility of settlement which may result in damage to adjacent buildings or other structures, gas, water, hydraulic or electric mains, sewers or road surfaces; and secondly, because any loss of ground or disturbance of the strata, if of a loose nature, may result in pressure greatly in excess of that of the undisturbed material being brought to bear on the timbering. Should this happen, movement of the timber may occur, and it may be found that insufficient room is available for the permanent work, which will necessitate the operation known as "poling back" and consequent loss of time in addition to the possibility of extension of the disturbance.

The amount of timbering needed in any excavation depends upon the nature of the ground and the length of time during which the excavation is required to remain open, and may range from an occasional support put in as a precautionary measure in rock, where fissured or laminated, to timbering completely covering the excavated faces in ground of a non-cohesive description, such as clean sand or gravel. In extreme cases it is necessary to go so far as to timber the bottom of the excavation in order to guard against the material being squeezed up by the pressure brought to bear by the sides.

The timber actually in contact with the ground consists of boards, known as poling boards, or long timbers called runners, driven down as the excavation proceeds, and unless the ground is of a strongly cohesive nature it is necessary to fill any cavities behind the timber either with loose material rammed in or with bricks, wood, or other suitable packing. In the case of loose sand, especially if water be present, the passage of the particles through any small openings between the timbers is often prevented by the insertion of hay or straw, this operation being sometimes known as "stenning." This, although it does not prevent the flow of water, stops to a great extent the sand which would otherwise accompany it.

In all cases it is of the greatest importance that the area of ground at any time temporarily unsupported during the fixing of the timber should be restricted to safe limits. It should be remembered that although the ground will in many cases stand with little or no support for a short time, heavy timbering may be needed if the excavation is required to be kept open for a long period. Clay usually swells when exposed to the air, and this may impose heavy pressure upon the timbering and render desirable the taking out of the excavation when it is required to accommodate permanent work, to dimensions somewhat in excess of those actually required.

It would appear that, although the nature of the ground may be the same throughout the whole depth of a trench or shaft, in many cases the pressure exerted on the timbering does not, even approximately, vary in proportion to the depth below the surface. In most cases it will be found that the timbers comparatively near the surface have at least as much pressure to resist as those below. This may be due to the greater effect of the vibration due to traffic on the top portion than on the lower part. In the case of wet silt or similar material the pressure may possibly be more or less proportional to the depth below the surface.

With reference to the kinds of timber used for the purpose under consideration poling boards and runners are usually of spruce and the heavier squared timber of pitch pine. Round bars are generally of larch and the best wood for wedges and pages is beech or other hard wood, although pitch pine is frequently used.

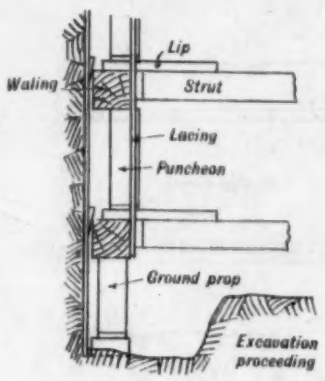


Fig. 1

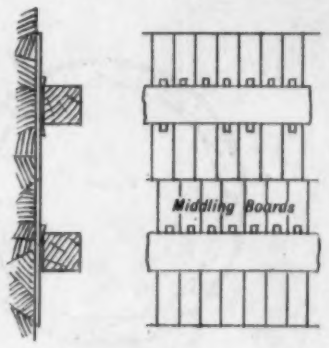


Fig. 5

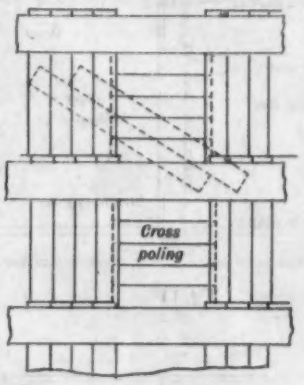


Fig. 8

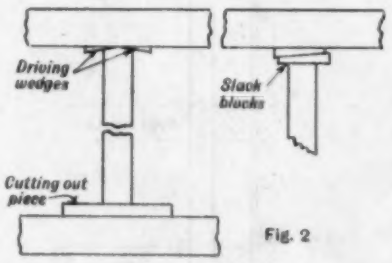


Fig. 2

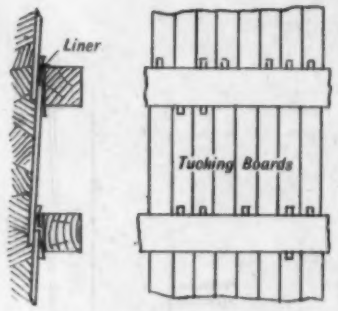


Fig. 6

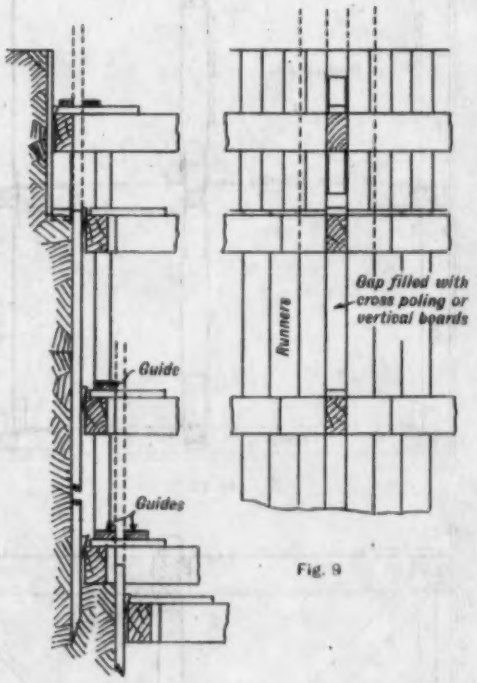


Fig. 9

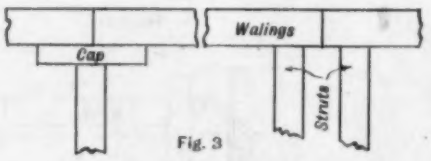
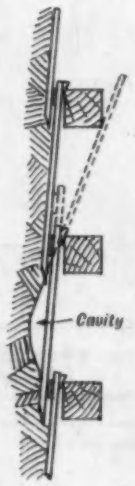


Fig. 3



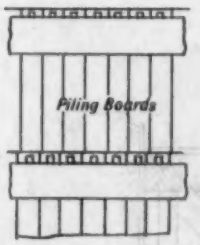


Fig. 7

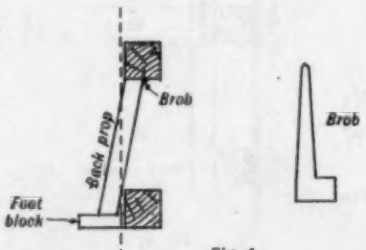


Fig. 4

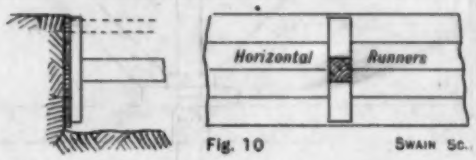


Fig. 10

"THE ENGINEER" SWAIN SC.

TRENCHES.

The use of poling boards to hold the sides of trenches will first be described.

The boards are usually from 3ft. 6in. to 4ft. 6in. long and 1¼in. thick. In all cases they are held against the ground by longitudinal timbers called walings, between which and the boards, pages (small wedges) are driven. Walings vary between 6in. by 3in. and 12in. by 12in. according to requirements, and when

of rectangular section they are fixed with the longer dimension vertical for convenience, although this is not the most economical method of resisting lateral bending. The walings are held apart by struts, the best section for which is square, their function being to resist compression. Round and rectangular timbers are, however, frequently used. In most cases strips of wood called lips are nailed to the tops of the struts at the ends to hold them level with the walings while they are driven into position, see Fig. 1. Large wedges, called driving wedges, are usually used to tighten up the struts, but in some cases slack blocks, as shown in Fig. 2, are used, these being more easily removed.

When considerable pressure on the timbering occurs it frequently happens, especially when the timber has been in position for a long time, that the frame—see Fig. 3. The latter method obviates the moving of struts if it becomes necessary to remove a waling without also removing the adjacent ones.

In order to prevent the dropping of walings vertical props called puncheons are wedged between them as in Fig. 1, the feet of the puncheons resting on the lips of the struts, if any. Lacing boards are also nailed vertically to the faces of the walings near their ends. It is essential that, as the excavation proceeds, the lowest walings should always be securely propped from the bottom of the excavation. Should the bottom of the trench be very soft it is sometimes necessary to prevent the settlement of the timbering by slinging it from timbers laid transversely across the top of the trench. In the event of there being a tendency for cavities to occur behind timbering—which should, of course, be prevented if possible by

ground is met with. The usual method of fixing the first setting is as follows :—The trench having been excavated to the requisite depth for the reception of the boards the walings are placed in position, resting on temporary props or packing, with poling boards behind them opposite the points at which the struts are to be fixed. Packing pieces are put in between the boards and the walings to allow room for pages in front of the boards subsequently inserted. The struts are then placed between the walings with their lips resting on the latter, and are driven into position, driving wedges then being inserted. The remaining boards are then placed behind the walings and held against the ground by means of pages driven in above the walings and sometimes below as well. In good ground open poling (leaving spaces between the boards or putting in alternate boards only) is fre-

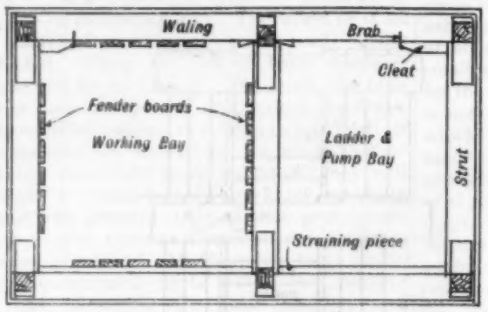
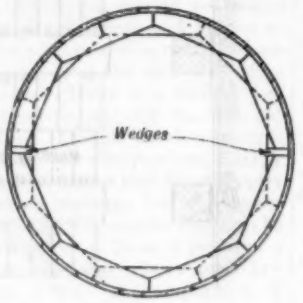


Fig. 11



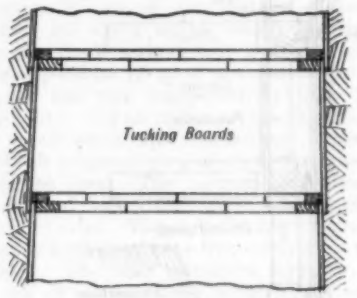


Fig. 14

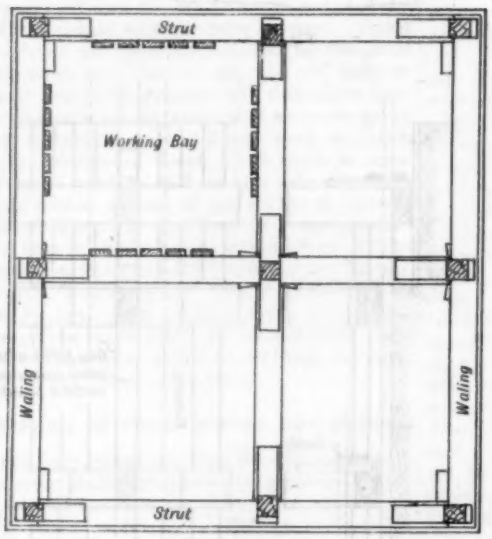


Fig. 12

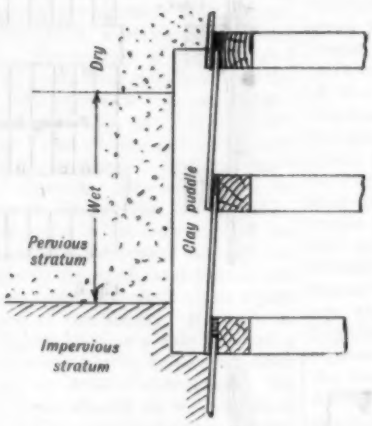


Fig. 15

Fig. 16

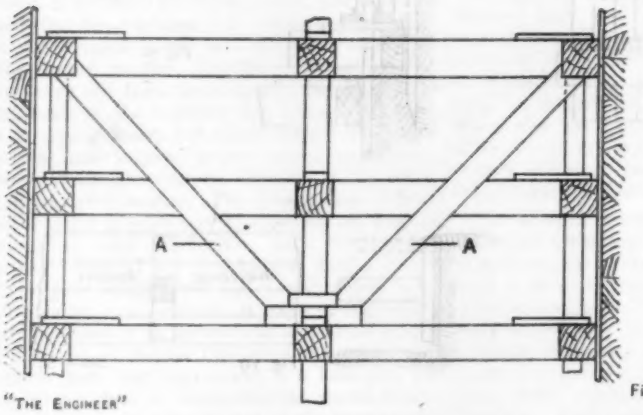
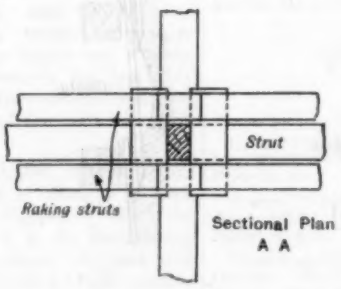


Fig. 13



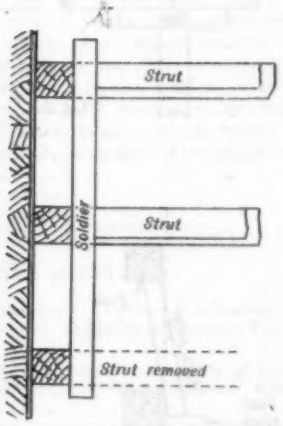


Fig. 17

"THE ENGINEER" SWAIN Sc.

struts cannot subsequently be knocked out on account of their having been forced into the walings, which have been partially crushed. When this is anticipated "cutting out pieces"—Fig. 2—are inserted between the struts and the walings. These distribute the thrust on the walings, and if any crushing occurs the cutting out pieces are damaged instead of the walings. Cutting out pieces are removed in the manner indicated by their name and the waste of valuable timber avoided.

Struts are fixed at both ends of walings and as many intermediate struts as necessary are added, the distance apart of the struts depending on the nature of the ground, the size of walings and the working room required between the struts. In fairly good ground caps are sometimes placed alongside the butt joints between the walings and single struts used, but usually two struts are employed, two opposite walings with the struts between them forming a complete

all means available—the walings and struts may be held together by timber dogs This will prevent the possible collapse of the timbering due to the walings moving outwards. In order to prevent the settlement of the timber in deep trenches it is usual to insert at intervals, possibly under every third or fourth frame, midway between the struts, raking or back props, as shown in Fig. 4, two of these being fixed under each waling as the excavation proceeds, resting on foot-blocks securely driven into the ground.

There are three methods of fixing poling boards in general use, these being known as the middling board, tucking board and piling board systems.

Middling Boards.—In this method—Fig. 5—each setting of boards is held in position by a single waling placed along the middle of them. This is only used in fairly good ground and has the disadvantage that it does not readily lend itself to the adoption of the piling board method—to be described later—if bad

quently used. The excavation for the second setting is then proceeded with. In this case the whole of the boards may be placed in position before the walings are fixed, the lower ends of the boards being toed into the ground or kept in position by pages and the tops held by nails driven obliquely into the boards above. Walings and struts are then fixed as before, puncheons are wedged between the frames, and lacing boards nailed on.

Tucking Boards.—In this method—Fig. 6—which is used in ground not sufficiently good for middling boards or where bad ground necessitating piling boards may be met with below, the poling boards are held at both ends. The walings, with the exception of those at the top frame, have nailed to them liners of the same thickness as the boards. The poling boards above the walings pass behind the liners and their lower ends are about level with the bottom of the walings. The boards of the setting below are subse-

quently "tucked" into the space thus formed below the liners. The method of fixing the frames is as described for middling boards, except that the temporary support of the top walings while the struts are put in is usually afforded by raking ground props which do not interfere with the fixing of the frame below.

Piling Boards.—Piling boards—Fig. 7—are used in bad ground. The boards are bevelled off at the lower ends and are usually driven as shown. Distance pieces called chogs are, in the first place, inserted between the liners and the walings, and these are taken out as required to admit of the driving of the piling boards. The piling board method has the advantage that the sides of the trench can be supported during the whole of the time excavation is proceeding, the toes of the boards being kept slightly below the level to which the bottom has been excavated. Driving is commenced at a considerable angle from the vertical and the boards assume the right batter as they are driven. In order to prevent them from approaching too near the vertical, chogs are placed between them and the boards above. It is obvious that a small cavity behind the boards, as shown in Fig. 7, is inseparable from this method of driving, and sometimes the method shown in Fig. 8 is adopted to avoid this. In this case the boards are driven on the slant laterally and are gradually righted. When only a small gap is left between the boards, if driving has been done in opposite directions towards the same point the gap is filled with cross poling as shown. If it is found necessary to resort to the use of piling boards after tucking boards, this is effected by removing the liners from the lowest tucking frame.

Runners.—Runners—Fig. 9—are frequently used in bad ground instead of poling boards. They are long timbers up to 20ft. and occasionally more in length and from 2in. to 3in. thick by 6in. to 9in. wide. The lower ends are toed or bevelled off and the heads are sometimes bound with hoop iron. The runners are driven down behind the frames, which are from 3ft. to 5ft. apart, the pages being loosened to enable this to be done. As in the case of piling boards, the toes of the runners are kept slightly below the bottom of the excavation and the sides of the trench are never unsupported. Sometimes runners are used for the full depth of the trench, in which case the top frame may be laid on the surface, a guide being fixed at a higher level to ensure the runners being driven vertically and to balance the pressure exerted by the ground. A scaffold or other means whereby the men are enabled to drive the runners is also necessary. Frequently a setting of poling boards is used at the surface, as shown in Fig. 9, to obviate the use of the guide above ground and to reduce the height of the scaffolding. This method is also adopted when the depth of the trench is slightly greater than can be reached conveniently with one or more sets of runners.

Whenever runners are used below either poling boards or another set of runners, internal frames—Fig. 9—are needed to enable them to be driven in front of the frames above. This necessitates the taking out of the upper part of the trench to a width sufficient to allow for the internal frames. It is obvious that gaps must occur between the runners under the struts of the frames above and, if the nature of the ground permits, the small spaces are left until the fixing of the frames below enables boards to be inserted. Sometimes, however, puncheons are placed sufficiently far back to hold the ground at these points, and in the event of raking props being used these may serve the same purpose. Should it be found undesirable to leave the small areas unsupported, cross poling may be inserted horizontally behind the runners.

Occasionally horizontal runners are used in small trenches, as shown in Fig. 10. Sufficient ground is excavated to enable a pair of runners on opposite sides to be placed on edge and temporarily strutted. When several runners have been put in vertical walings are placed in position and strutted apart, one or more struts being used for each pair.

SHAFTS.

Shafts may be regarded as short lengths of trench timbered at the ends and the methods of timbering hitherto described are applicable, the choice of method depending, as in the case of trenches, upon the strata. The purpose of shafts is, very frequently, to enable tunnels to be driven from them, and they therefore have in many cases to be sunk to greater depths and to remain open for longer periods than trenches. It is necessary, therefore, that in these cases even greater care than usual should be taken in the timbering. In deep shafts raking props previously described are of great importance. The struts are fixed across the short dimension in a small rectangular shaft and the end struts have, in addition to fulfilling their usual function of keeping the walings in position, to act themselves as walings. These end struts are sometimes called "stretchers." The lateral movement of the end struts is prevented by means of cleats or straining pieces—both shown in Fig. 11—the latter being preferable. The walings also act as struts. In the case of a shaft sufficiently large to require strutting in both directions, as, for example, that shown in Fig. 12, the transverse struts are usually continuous timbers, the longitudinal struts being inserted between them in short lengths.

In designing the timbering of a shaft it is important not to arrange for timbers of such length that, owing to the struts above the frames for which they are intended, they cannot be put in. In some cases walings, instead of running the whole length of a shaft, as is usually the case where practicable, have to be in sections, butt jointed and capped opposite struts. Sometimes it is possible to omit struts or to fix temporary ones in suitable positions until the timbers of the frame below have been placed in position. Props are fixed between the struts of adjacent frames at the points of intersection of transverse and longitudinal struts. In a shaft divided into bays by struts it is necessary to consider the size of working bay required in order to give adequate space for the passage of skips, brick boxes and the like, and it is frequently necessary, therefore, to space the struts at unequal intervals. Vertical fenders are nailed between the frames in the working bay to prevent the skips, &c., from being caught by the walings or struts. Provision must be made in the other bays for ladders, pipes of various kinds and pumps as may be necessary. It is desirable, if possible, to keep struts clear of the centre line of the tunnel to be driven from a shaft in order to facilitate setting out.

In large shafts, in which great pressure is expected to be exerted on the timbering, it is necessary to prevent the upward buckling of the struts by means of raking struts. In order that these should be at a suitable angle it is sometimes desirable to fix them between a frame and the struts of the second or third frame below, and in this case the intervening struts are in the way. The best method of dealing with this case is probably to use double struts, one on each side of the intervening struts, the lower ends of which rest on saddles, as shown in Fig. 13.

Sheet Piling.—Shafts in very bad ground are occasionally sunk with the aid of sheet piling. The method is essentially similar to the use of runners, as sheet piles may be regarded as large runners. The

Fig. 18.

"THE ENGINEER" SWAIN Sc.

toes of the piles are generally shod with iron and are cut diagonally in the usual manner, the object being that each pile when driven shall be forced against the adjacent pile. If necessary, the piling may be caulked, hoop iron and yarn being frequently used for this purpose. Interlocking steel piling is occasionally used instead of timber sheet piling.

Circular Shafts.—A convenient method of timbering circular shafts is to use frames each consisting of two semi-circular ribs, similar to those used for arch centering, which are fixed by being wedged apart against the poling boards—see Fig. 14.

Excluding Water from Shafts.—It sometimes happens that, after passing through a water-bearing stratum, a shaft is sunk for the remainder of its depth in dry material, and unless steps are taken to prevent it the water will run down to the bottom, both behind and in front of the boards. The method sometimes adopted to obviate this, if the ground permits, is to take out a setting of boards, the bottom of which is below the top of the impervious stratum (one board being removed at a time) and to ram in clay puddle, sufficient excavation being done to admit of this—see Fig. 15. If the depth of the water-bearing stratum is not great, practically all the water can be excluded in this way by treating as many settings as required in the manner described, but should the wet stratum be too deep to enable this to be done economically, puddle may be put in behind the setting at the top of the impervious stratum to prevent the water from passing behind the boards below, and the water which runs in from above is collected in a channel, usually called a garland, and either passed down a pipe to a sump at the bottom of the shaft, from which it is pumped, or raised to the surface from a small tank at the level of the garland. In the case of runners clay puddle can be inserted in the same way as for boards by raising the runners one at a time, and, after putting in the clay, driving them down again.

An alternative method sometimes used is to make a seal with clay at the top of the impervious stratum as before and to force in cement or lime grout under pressure, clay being used to prevent the grout from flowing into the shaft between the boards or runners.

Removal of Timbers or Parts of Timbers.—Should it be necessary for any purpose to remove one or more struts, this is done by means of "soldiering," which consists of placing near each end of the struts to be removed vertical timbers called "soldiers," extending over three or more walings and bearing against the walings from which the struts are to be removed—see Figs. 16 and 17. Portion of a waling in a trench may be removed by inserting struts, one at each end of the gap to be formed and then cutting out as required. The whole waling may be taken out if the opposite waling is supported by raking struts from the frame below the timber to be removed—Fig. 18—or, alternatively, soldiers and struts may be used to support the opposite waling, as in Fig. 16. In the case of shafts the removal of a portion of a timber acting both as strut and waling necessitates soldiers, soldier struts and also struts to hold in position the severed ends of the timber. For the removal of the whole of such a timber soldiering only is needed, so far as the frames are concerned, but alternative support may have to be given to the boards or runners behind the timber taken out.

Refilling Trenches and Shafts.—In refilling excavations only as much timbering is removed as can be done with safety, and unless the work is so situated that settlement is of no importance, it is almost as essential that the ground should be secured during refilling as during excavation. Thorough punning of the refilled material is very important. Sometimes water is used to assist in consolidating the material. In some cases all timber is left in; in others the frames are removed, boards or runners being allowed to remain and sometimes a few poling boards are left in where the ground necessitates this. Frequently, however, all timber can be taken out. Frames are removed just in advance of the refilling or construction of the permanent work.

If boards only are being left in, the securing of a setting of piling or tucking boards by filled-in material or permanent work holds the toe of the setting above on account of the overlapping of the settings, but in the case of middling boards it is sometimes necessary to provide some temporary support for the top of the setting while the frame is removed and the greater part of the setting secured. The leaving in of middling boards is, however, rarely necessary. In removing middling boards or tucking boards the ground must remain unsupported between the removal of a setting of boards and refilling, but piling boards and runners can be gradually withdrawn as the filling proceeds. The top one or two frames and settings of poling boards are sometimes left in as a precautionary measure when deep shafts are refilled.

New Coal Handling Plant at Beckton.

ON Saturday afternoon last, July 10th, His Majesty the King, who was accompanied by the Queen, visited the Beckton Gasworks of the Gas Light and Coke Company and formally opened the new coal-handling plant which we illustrate on the opposite page. The combined equipment of cranes and conveyors, which, when completed, will be capable of dealing with 2000 tons of coal per hour, is claimed by the owners to be the largest installation of its kind in Europe.

Since its incorporation by Royal Charter in 1812 the Gas Light and Coke Company has grown to be the largest gas undertaking in the world, supplying light, heat and power over an area of approximately 265 square miles. In order to provide the enormous quantity of gas—a yearly output of 235,000,000 therms—for this area it is necessary to carbonise no less than two and a-half million tons of coal per annum. Beckton is the largest of the company's works, and it is responsible for over 40 per cent. of the make of gas. Coal is transhipped from the company's own ships into barges at Beckton for the various London works.

When the Beckton works were laid down in 1870 in the Essex marshes the No. 1 pier built at the side of the Thames for unloading the coal ships was of an "L" shape and the coal was handled in skips by small hydraulic cranes. At a later date another arm was built on to No. 1 pier, making it of a "T" shape and available for unloading three or more ships. In 1893, however, the amount of coal to be dealt with had outgrown the capacity of this pier, and for coal unloading purposes it was superseded by the then new No. 2 pier. The second pier was also of a "T" shape and on three sides of it four hydraulic luffing cranes were erected, fitted with grabs having a capacity of 50 tons per hour. In this manner three ships could be dealt with. When No. 2 pier came into use No. 1 pier was reserved for the handling of residual products.

The unloading plant which thirty-three years ago was erected on No. 2 pier has now become inadequate owing to the continued growth of the company's business and the increased quantity of coal to be dealt with. To meet the new conditions No. 1 pier has been reconstructed—see Fig. 1—and fitted with cranes and conveyor equipment, and in turn No. 2 pier will now be used for handling residual products.

The reconstruction of No. 1 pier in order to strengthen it for carrying eight new 120-ton electric travelling cranes was accomplished by sinking twenty new caissons into the river bed and spanning their

NEW COAL HANDLING PLANT AT THE BECKTON GASWORKS

(*For description see opposite page*)

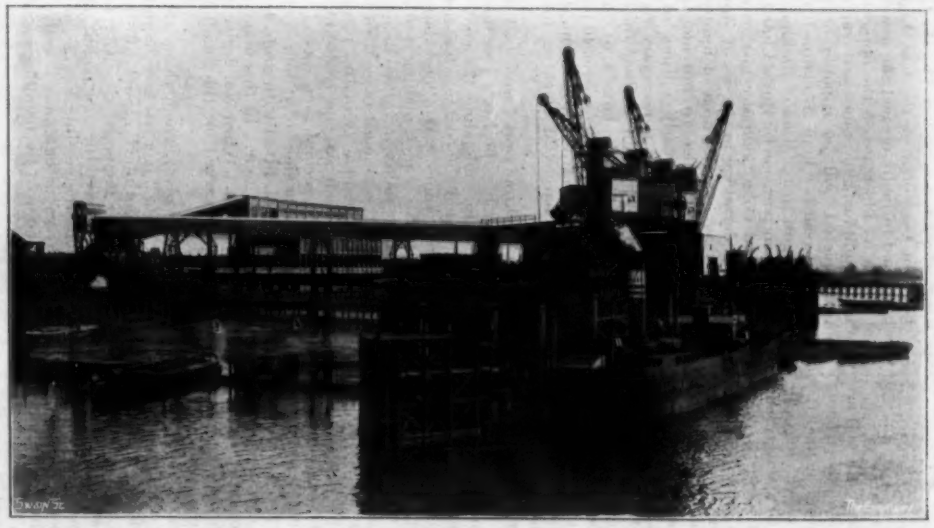


FIG. 1—RECONSTRUCTED PIER AND COAL-HANDLING PLANT

FIG. 2—54in. BELT CONVEYOR OVER STORAGE HOPPERS

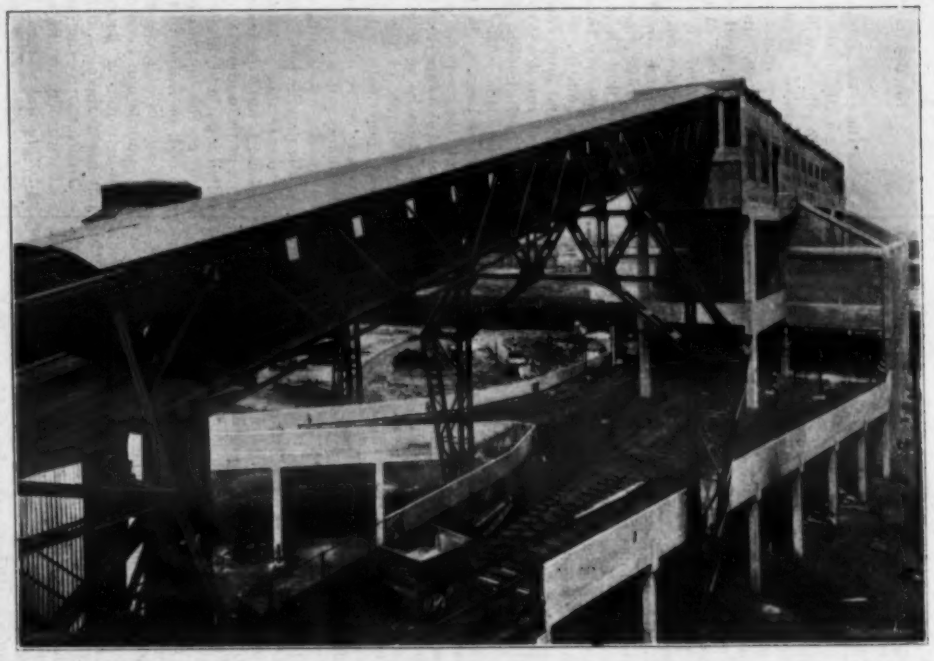


FIG. 3—RAILWAY VIADUCT WITH INCLINED BELT CONVEYOR

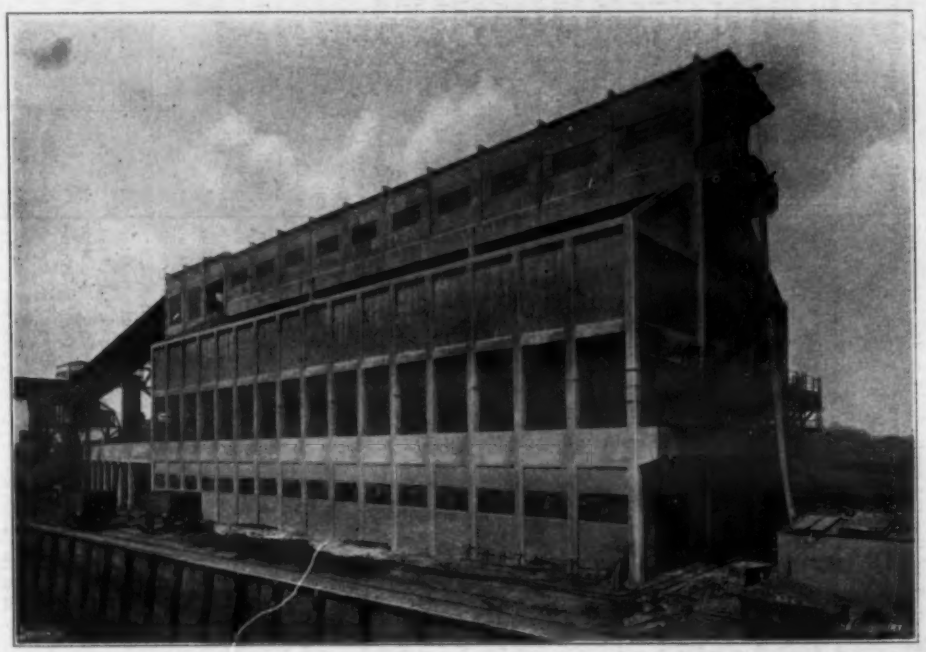


FIG. 4—9000-TON COAL STORAGE HOPPERS

tops with a girder construction, which passes over the top of the old pier and takes the crane tracks. The top part of each caisson has a diameter of 6ft. and is 50ft. long, whilst the foundation part is 10ft. in diameter with a length of 20ft. Each caisson is driven down to the chalk, a depth of about 25ft. At high water the rail level of the pier is 28ft. above the river, while the distance between the rail level and the river bed is 48ft. The girders spanning the pier have a length of 58ft., with a depth of 7ft. 6in., and they each weigh 24 tons. This part of the constructional work was carried out by Sir William Arrol and Co., Ltd., of London and Glasgow.

Four cranes are to be fitted on each arm of the pier, of which the first four—see Fig. 1—are already in position and the other four in hand. They are 120-ton cranes of the Shoosmith portal and centre post electric travelling type and each is equipped with a 3½-ton Priestman grab. The grab, which has a handling capacity of 250 tons per hour, is designed to make about seventy lifts per hour at a speed of 250ft. per minute. A hoisting motor of 120 brake horse-power is fitted and the height of the lift from the ship to the feed hoppers is nearly 70ft.

The crane grabs deliver the coal into 20-ton feed hoppers, from which it is discharged on to two rubber belt conveyors, one running along each arm of the pier, each of which is designed to handle 1000 tons of coal per hour. The belts are 48in. wide and travel at a speed of 500ft. per minute. Arrangements are made to weigh the coal automatically as it passes over the belts. At the junction of the two belts at the centre of the pier the coal passes either downwards to chutes for loading barges or on to a third belt conveyor of 2000 tons per hour capacity leading shorewards. This third conveyor feeds a fourth inclined conveyor—see Fig. 3—which in turn leads to a fifth conveyor over the coal storage hoppers shown in Fig. 2. The three conveyors last referred to each have belts 54in. wide and travel at a speed of about 600ft. per minute. Fraser and Chalmers Engineering Works, of Erith, supplied the belts—which work on the Robins system—and also built and erected the cranes and the belt and conveyor supporting structures. Electric power for the crane and conveyor motors, of which 710 brake horse-power is required for the belt motors alone, is supplied from the company's own power station. It is generated by turbo-alternators at a pressure of 440 volts alternating current, and the steam for the turbines is raised in waste heat boilers, in which the heat left in the furnace gases is recovered after these gases have performed useful work in heating the retorts.

In Fig. 4 we reproduce a photograph of the new reinforced concrete coal hoppers with the conveyor house over the top. The hoppers were designed by Considère Constructions, Ltd., and the whole of this work as well as the construction of the new concrete viaduct connection to the existing overhead railway system was carried out by Concrete Piling, Ltd. The hoppers are designed to hold 6000 tons of coal and have a length of 160ft., a width of 70ft., and a total height over the conveyor housing of 83ft. The height to the conveyor level is 66ft. and the bottom of the bunkers is 31ft. above the ground level and 12½ft. above the works overhead railway system. As shown by Fig. 3, there are six tracks of rails laid beneath the hoppers, and when the trams are shunted into position the balanced discharge doors of the hoppers are automatically opened and the trucks rapidly loaded for transport to the retort houses or storage grounds. The coal is removed in 5-ton trucks, of which there are sixteen to a train, giving a total capacity of 80 tons. In order to speed up the train system daylight signals similar to those in use on the London Underground Railways have been installed. Some of these signals are indicated in Fig. 3. The space between the overhead railway deck and the ground level forms an engineers' store.

On Saturday last, after setting in motion the machinery we have described, the Royal party was conducted over the gas and chemical works by the Governor of the Gas Light and Coke Company, Mr. D. Milne Watson, and a visit to the company's playing fields at East Ham was made.

Obituary.

JAMES THOMAS.

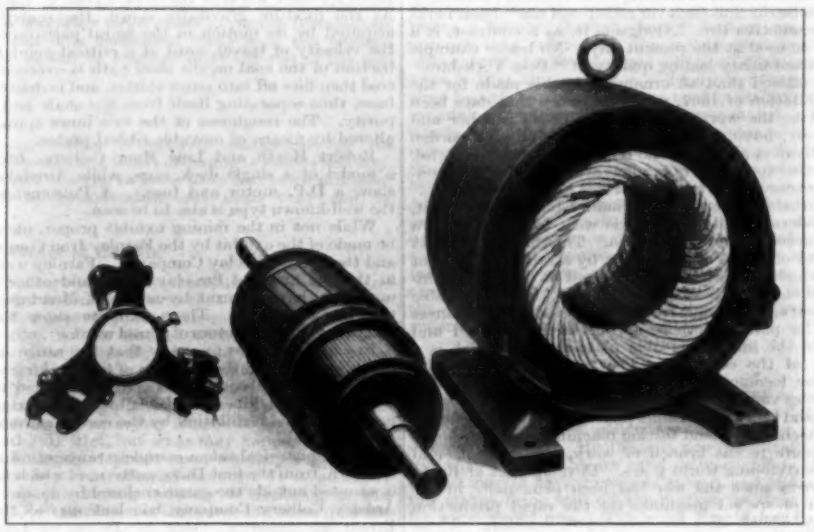
MR. JAMES THOMAS, who was manager of the Dowlais-Cardiff Steel Works from 1897 until his retirement in 1920, died at his home at Cardiff on the 8th inst., at the age of seventy-six years. Mr. Thomas, who was a native of Pembrokeshire, obtained his early experience of the steel trade at Landore, after which he went to the Newton Steel Works at Glasgow. Just over fifty years ago he returned to South Wales and assisted the late Mr. Isaac Butler to start the Panteg Steelworks. Subsequently he returned to Glasgow as the manager of a steelworks there, and was the first man to undertake steel casting in Scotland. He also introduced steel casting at Barrow-in-Furness, while in later years he was largely responsible for the success which was achieved by the steel department at the Dowlais-Cardiff Works during the years that he was manager.

A New Phase Advancer.

THE increasing practice of supplying electricity at charges varying according to the power factor of installations has caused considerable attention to be paid by users of electricity to the questions of power factor improvement. To the equipment available for power factor correction a new phase advancer has been added by the Metropolitan-Vickers Electrical Company. The machine is claimed to combine many operating characteristics unobtainable with other types of phase advancers, whilst its simplicity results in low initial cost and minimum maintenance expenses.

As shown in the accompanying illustration, there are only three main parts, the stator, rotor, and a three-arm brush rocker. The low generated pressure of the machine, which rarely exceeds 25 volts, ensures almost complete immunity from insulation troubles. An interlocked three-pole throw-over switch is the only additional control gear that is required, and in some cases even it may be dispensed with.

The new machine has the advantage that it can be supplied to produce either unity or any desired leading power factor at full load. Instead of the compensation falling off at light loads, as with some alternative devices for power factor correction, the main motor can be made to draw a considerable leading current to compensate for lagging current in other parts of the system. In most cases, and particularly where the required power factor correction is small, the overall efficiency is improved, whilst in all other cases the loss in efficiency will be practically negligible. As some of the existing methods of power factor correction involve a serious loss in efficiency, this, the makers explain, is a matter of particular importance.



PHASE ADVANCER DISMANTLED

The phase advancer enables the motor to deal with greater instantaneous overloads. An instantaneous overload capacity of 100 per cent., for example, would be increased to 150 or 175 per cent. The new phase advancer also reduces the slip, or, in other words, the difference between full load and no load speeds.

In principle the machine is based on that of the phase advancer designed for the Metropolitan-Vickers Company by Professor Miles Walker, about sixteen years ago, but important improvements have made possible a greatly simplified construction, resulting in lower first cost and maintenance expenses, greater reliability, and better operating characteristics. In its latest form the Metropolitan-Vickers phase advancer is a simple alternating-current exciter similar to a direct-current exciter, and it is connected in the rotor circuit of a synchronous induction motor. It differs from the usual direct-current exciter in that it has a series connected field winding instead of a shunt winding. The series field arrangement gives the phase advancer a self-regulating characteristic, so that the voltage generated by the exciter increases with increase of load on the main motor. The current circulating in the phase advancer circuit is produced by the resultant of two voltages; the electromotive force produced by the conductors on the rotor of the main motor slipping back through the rotating field and the electromotive force generated in the armature of the phase advancer. The arrangement of the circuit is such that these two pressures assist one another. If the load on the main motor increases the slip becomes greater, the electromotive force due to slip increases, and consequently the resultant electromotive force in the circuit is also increased. This causes a corresponding increase in the current circulating, which, since the phase advancer is provided with a series field, results in an increase in the voltage generated by this machine. These two voltages rise until a current circulates with sufficient power to produce the required torque in the main motor, the phase advancer being so designed that this current is automatically produced with the desired amount of phase compensation.

On systems where a new motor is to be installed the phase advancer is most conveniently arranged on a common bed-plate directly coupled to the motor, whilst for use with existing motors, phase advancers can be driven by a small auxiliary motor or arranged for belt or chain drive from the existing motor or from a convenient line shaft. The amount of power factor compensation is varied by rocking the phase advancer brush gear. The position of the brushes for which any phase advancer has been designed is marked clearly on the machine, and also the limits between which the brush gear may be moved to vary the amount of compensation. The cable connections consists of three leads from the phase advancer brushes to the main motor slip rings.

It is important for a consumer who is considering the question of installing apparatus for power factor correction to obtain the best return for his outlay. When only a moderate degree of power factor correction is required, as, for example, when the motor considered requires to be corrected to unity or 0·95 leading power factor, the phase advancer is claimed to show great advantage over other arrangements, such as synchronous motors or synchronous induction motors. The field of application of the phase advancer includes (*a*) power factor improvement on existing plant where extensions are not contemplated; (*b*) power factor improvement on new plant or where extensions are being made. Under condition (*a*) the installation of a separately driven phase advancer will, it is considered, in most cases be found the most effective and economical solution, provided that one or more motors of at least 35 to 40 horse-power are available for compensation. Where there are no existing motors of sufficient individual capacity a favourable case can usually be made out for the use of static condensers. Under condition (*b*) the phase advancer used in conjunction with an induction motor shares the field of economical application with the salient pole synchronous motor and the synchronous induction motor, depending largely upon the degree of compensation required. With medium-sized units, *e.g.*, between 40 and 300 horse-power, the use of phase advancers will in many cases give the necessary compensation at lowest cost. An important advantage offered by phase advancers over some other means of power factor correction is that they enable the consumer to use the ordinary robust type of slip-ring motor. The phase advancer here described adds no appreciable maintenance expenses to the running costs of the system, and where energy is purchased under a tariff varying with power factor it effects savings which soon cover the cost of its installation.

The Leeds Tercentenary.

LEEDS is now celebrating the Tercentenary of the granting of her Charter of Incorporation at the hands of Charles I., by whom she was raised from a simple manor to the rank of a borough. Her history is the story of industry's rise, and is being told to the citizens by a composite exhibition in the Town Hall and Crypt, covering all the most important of the "ninety-seven" industries of Leeds. As one would expect, engineering and allied trades have contributed the major part of the display, but before dealing with this section we may briefly outline the other activities of which Leeds is the home.

Leeds was known in the thirteenth century as a centre of the woollen trade, and that commodity dominated the life of the town for four hundred years. Only with the advent of the industrial revolution with its rapid development in the working of coal and iron was there any challenge to its supremacy. This development gave the initial impetus to Leeds engineering which, during the nineteenth century, was the main feature of the city's industry. In its turn that has had to yield place since 1855 to the wholesale clothing industry, which now employs about 30,000 of the inhabitants, and engages the attention of over 400 firms.

THE ENGINEERING EXHIBIT.

Leeds is mainly famous for the heavier type of engineering work, such as locomotive building, in which five firms are engaged; heavy machine tools, in which the number of firms engaged has decreased since the early days; the construction of gasometers and large tanks, heavy agricultural machinery, textile machinery and mining machinery, to mention only a few branches. It was therefore impossible for the organisers of the Exhibition to show the full range of the engineering activities of the city in its actuality. It has had to be done by means of models and photographs. The lighter branches, however, have contributed many specimens of their products, and the Exhibition, though confined in space, is not lacking in attractiveness to both the technical man and to the public.

In some of the exhibits an attempt has been made to depict history. Thus the actual lathe made and used by John Smeaton, who was born near Leeds, is to be seen.

As was natural there is a considerable number of exhibits

connected with the locomotive and railway engineering industry, for which Leeds has a long and proud history. Brief reference may be made to the historical side, commencing with an exhibit of Matthew Murray relics, lent by South Kensington Museum and by private individuals. Murray, it will be remembered, went to Leeds in 1789, and there carried out all his epoch-making inventions in general engineering and, in particular, locomotive work. A model of the Blenkinsop locomotive, which he built for work on the Middleton Colliery wagon way to Hunslet, is exhibited by Mr. Harding Churton, of Leeds. Another interesting exhibit in this section is a plate showing the types of locomotive made by Kitson and Co., Leeds, between 1840 and 1867. Photographs of Alfred Krupp, the founder of the famous armament works in Essen, and J. A. Krupp, his son, are shown. It is a little known fact that the two sons both worked as apprentices at the Leeds engineering firm of Smith, Beacock and Tannett. This firm of machine tool makers, not now in existence, supplied much of the plant for the works at Essen.

It has been impossible to incorporate much actual machinery made by the locomotive firms and tool makers in the limited space available. Certain of the firms are therefore not fully represented. Kitson and Co., Ltd., show a sectioned cylinder casting and numerous photographs of their locomotives. John Fowler and Co. (Leeds), Ltd., show an interesting model of a 30 horse-power motor locomotive, scale 1in. to 1ft. It represents one of the recent developments of the firm, which is confining its attention in this class of work to the building of light railway locomotive and rolling stock, especially for plantation work. We may note that this year sees the centenary of Mr. John Fowler, the founder of the firm. The Monkbridge Iron and Steel Co., Ltd., is exhibiting what the firm confidently believes to be the first tire ever rolled—an old "Best Yorkshire" locomotive tire. Alongside it, as a contrast, is a steel tire as used at the present day. No better example of the extraordinary lasting quality of "Best Yorkshire" could be offered than an ornamental table made for the Paris Exhibition of 1867, which has since that date been subjected to the worst influences of Leeds weather and polluted air, having been used continually as a garden table. There is absolutely no deterioration in the metal. Various other specimens of forgings are exhibited to demonstrate the present-day products of this Leeds firm.

The Kirkstall Forge has a mainly historical exhibit, but a modern complete rear axle with brake gear for a 50 cwt. to 60 cwt. lorry is shown. This firm also shows the quality of best Yorkshire iron by a railway axle bent double, which was originally displayed at the 1851 Exhibition. Jonas Woodhead and Sons, Ltd., have a valuable stand of leaf springs made from high-class silico-manganese steel. The plates of these springs are all formed and erected on the interchangeable plate system, which is a speciality of the company. The range shown includes springs for locomotives, railway wagons, tramcars and road vehicles varying in weight from 3 lb. to 500 lb. Joshua Buckton and Co., Ltd., exhibit photographs of their heavy railway machine tool and testing machines, with examples of their more recent branch of work, the Bostock and Bramley enveloping worm gears. Development of Buckton products since the war has been principally in the perfection of special machines for the rapid production of railway wheels and for locomotive building. These include planing machines, boring and turning mills, and boring machines of large size and high capacity.

One of the largest stands in the Exhibition is that of the Yorkshire Copper Works, Ltd., which is built up entirely of copper, brass, cupro-nickel, aluminium, and other non-ferrous metal tubes. One of these is only ·005in. inside diameter and of 266ft. in length. We may note that this firm is experiencing little of the trade stagnation which has affected Leeds so badly. Probably the reason for this is that copper pipes for housing are rapidly supplanting those of lead and iron. One of the main features of the Greenwood and Batley, Ltd., stand is a large turbine disc.

Modern mining appliances are well represented, though time for preparation of the exhibit was limited and its scope, to include modern machinery, was only so extended at the last minute. William Johnson and Sons (Leeds), Ltd., show a model of a complete coal briquette making plant. In this plant small coal is emptied from a railway wagon to a storage bunker below ground, whence a bucket elevator carries it to a service hopper. At the same time pitch of suitable quality is fed by hand into a pitch cracker, from which it is elevated to a second service hopper. Automatic measures regulate the proportions of the two materials, which are approximately 92 per cent. coal to 8 per cent. pitch, and after being mixed together they are passed through a pulveriser and again elevated to a service hopper. Thence the mixture passes to the cooker, where it is treated by the injection of steam and agitated by revolving knives. The pitch becomes melted and the whole mass is reduced to a hot plastic condition, at which point it is discharged to a conditioner and conveyor. As the treated mixture passes along this conveyor the excessive heat is allowed to disperse, so that the plastic mixture is delivered to the pressing machine at the right consistency. Here briquettes are moulded from the material by the action of two rollers having suitable moulds, and as they fall away under the machine they pass either direct to the waiting wagons or they may be conveyed to storage hoppers. Plants such as this are designed for outputs of 3 tons, 5 tons, 10 tons, and multiples of 10 tons per hour. William Johnson's other exhibit is a compound ball and tube mill originally introduced as a single chamber mill for the manufacture of Portland cement, but adapted in this model for the production of stone dust. The use of this material is now compulsory where the underground working of the colliery is dry, and since it was first used in 1913 a number of serious explosions have been prevented. In the Johnson mill the grinding action is obtained by the slowly revolving tubes containing in one chamber a quantity of forged steel balls by which a rough grind is obtained, and in the other chamber by a number of flint pebbles giving a fine pulverisation. The material is ground to a fineness of 80 per cent. through a two hundred mesh, and the mill is made in sizes to deal with from 10 cwt. to 10 tons per hour.

It has been deemed advisable to include in the mining exhibits machines from firms outside Leeds, as the aim was not so much to depict the manufacture of mining machinery as to show the methods adopted in the West Yorkshire coal trade. Thus Mavor and Coulson, Ltd., of Glasgow, demonstrate the evolution of the bar coal cutter by means of a series of models. In this type the picks are considerably smaller than in the other two types. They are driven in a spiral round a tapered steel bar, which is revolved at high speed by a motor driving through gearing in direct mesh with the bar. The machine traverses by wire rope coiling on gear-driven drums, and the cutter bar may be swung into and out of the cut. Seven models are shown commencing with the 1879 Warslop and Hill's cutter driven by compressed air motor. In this type the primitive form of slewing gear is noticeable, and the haulage feed is effected by hand. The firm's coal cutter, made in 1897, to Hurd's patent, was the first to be fitted with completely enclosed motor, whilst the latest model of 1924 has the feature of side drum haulage to bring the pull of the haulage rope close to the coal face, thus avoiding the necessity of steel props. Models of the Crescent disc coal cutter, lent by A. Hirst and Co., Ltd., show the basal principle of saw-like teeth on a revolving disc. The latest design feed and traverse are given to the machine as a whole. As much as possible of the machine is enclosed in steel housing, and it moves along the coal face on steel runners. The largest exhibit on the stand is a full size cutter by Diamond Coal Cutter, Ltd.

F. and R. C. Kirkup exhibit a horizontal rotary cylindrical screen, while a model of a spiral separator is lent by Hugh Wood and Co., Ltd., of Newcastle. This latter differs from other types in that no water sluicing is needed. The machine depends for its action on the different coefficients of friction of coal on steel and shale on steel. Run-of-the-mine coal is fed at the siding to the top of the separator, which consists of three co-axial spiral paths inclined towards the centre post of the separator. As the mixture gravitates down, the centrifugal force acquired by its motion in the spiral path increases with the velocity of travel, until at a critical point the sliding friction of the coal on the steel path is overcome and the coal then flies off into outer chutes, and is delivered at the base, thus separating itself from the shale and other impurity. The roughness of the two inner spirals may be altered by means of movable ribbed plates.

Robert Heath and Low Moor Colliery, Ltd., exhibit a model of a single deck cage, while Airedale Collieries show a D.P. motor and fuse. A Pulsometer pump of the well-known type is also to be seen.

While not in the mining exhibit proper, mention must be made of the exhibit by the Farnley Iron Company, Ltd., and the Leeds Fireclay Company. Farnley was a pioneer in the gas firing of fire-clay goods and other refractory materials, having burnt by means of Mond gas for more than twenty years. These exhibits show the various stages in the manufacture of glazed ware.

In conclusion, we may say that the range of material exhibited here and the numbers of firms taking part reflect great credit on the organisers, who have had to contend with the many difficulties brought about during the preparation of the Exhibition by the continued unrest in the mining world.

On the historical side a complete range of miner's lamps is shown, from the first Davy pattern, in which the oil tube is situated outside the gauze enclosed by a cap. The East Ardsley Colliery Company has lent one of the original Briam anemometers, made by Davis, of Leeds, about 1850. The twelve vanes are steeply inclined to the direction of air flow, and the spindle carrying them gears with the recording dials, which are placed on the axis of the vanes. One revolution of the vane wheel corresponds in this instrument to approximately 1ft. of air velocity.

The classic experiments carried out by the late Sir William Garforth at Altofts on explosions in mine galleries are represented by a model of the test gallery lent to the Exhibition by Pope and Pearson, Ltd. Demonstrations of the propagation of flame during these experiments are given by means of moving pictures. The length of flame in the tests reached 170ft. Another historical exhibit, by Cook, Boulton and Sims, Ltd., includes old dumpy and drainage levels, and the fact that Leeds originated the methods of mechanical coal hewing is recorded by two working models of Firth's "Iron Man," lent by the Leeds University.

Leeds also made history in the evolution of printing, though examples of the famous Wharfedale press made at Otley, about nine miles away, are not shown, while it was obviously not practicable to give proper prominence to heavy newspaper rotary presses, of which R. W. Crabtree and Co., Ltd., Leeds, are one of the few makers. The firm of George Mann and Co., Ltd., exhibits a rotary offset machine of modern type, which is in operation daily. Other machines, also working, include an up-to-date Linotype machine and a Monotype machine. This printing exhibit is peculiarly valuable from the historical standpoint, and copies of the *Yorkshire Post* in its early days as the *Leeds Intelligencer* and a *Leeds Mercury*, nearly two hundred years old, are shown. The connoisseur of modern printing will find a series of posters and illustrations by the litho-offset process in as many as sixteen colours. Leeds is one of the chief centres of the printing trade in England today, as instanced in this exhibit of posters, catalogue and booklet work, and photogravure colour printing, and is giving a lead to the printing trade by the adoption of the new gravure process, specimens of which show a remarkable range of effect with very few printings.

In general engineering M. Glover and Co. show a range of saw guards, which they began to manufacture in 1898, after the introduction of legislation requiring the protection of high-speed tools. The firm also shows a new spindle moulding machine guard, together with a quarter size working model of firewood machinery, by means of which wood blocks inserted into the feed trough are gripped by spiked rollers and fed under powerful knives. These can be adjusted to cut thick or thin sticks as required. Thence the sticks pass through a hopper and are fed to a bundling machine. A full size gulleting and sharpening machine on the revolving emery wheel system is another original invention by the founder of the firm here to be seen.

The pumps of Hathorn, Davey and Co., Ltd., are represented by large photographs of the vertical triple-expansion pumping set, recently delivered to the Metropolitan Water Board, which pumps 14,000,000 gallons of water per day into the London mains. The steam consumption of this engine was ascertained at the official trial to be 10·67lb. of steam per pump horse-power hour. The firm's patented "Helivane" pump is also exhibited.

On the stand of T. F. and J. H. Braime, the central feature is an exhibit of pressed steel sea mine casings, comprising the original Admiralty type, the British Ellis type of Vickers mine, and the French and American types, together with the original aeroplane bomb and trench bombs. Further items of interest on the stand are pressed steel elevator and conveyor buckets, seamless steel oil feeders, seamless steel oil drums, ship's engine-room lamps for all purposes. Motorists will be specially interested in the motor car pressed steel parts, such as back and front axle brake drums, hub caps, and wheel centres for wire wheels.

A 6 horse-power 950 revolutions per minute two-phase motor, 50 cycles, 200 volts—the first alternating-current motor made by T. Harding, Churton and Co., and probably the first to be manufactured in the North of England—is seen alongside a modern motor by the firm. It has been working for over twenty years in a local newspaper office without any but the most cursory attention. There was no two-phase supply distribution in Leeds when this motor was first made.

In this review of an Exhibition covering such a wide range, there has necessarily been omitted mention of many stands. We have sought to confine our attention to such of the historical and modern exhibits in engineering as would appeal to the general reader. An American publicist told Leeds last year to advertise itself. To the commercially minded, this Exhibition and the general nature of the celebrations of the Tercentenary, which includes processions and pageants, tattoos and street decorations, as well as open days in the Corporation gas, electricity, sewage and other departments, may appear as an attempt at that publicity. Frankly, it is not so primarily, for the exhibitors and those responsible for the arrangement of the display have been actuated wholly by civic pride. We are apt to take the existence of any big industrial centre too much for granted, and it is only when, on such an occasion as this, we are able to take a perspective view of grouped industry, we are able to appreciate its power and dignity, and to understand its far-reaching effects on the lives of the community.

South African Engineering Notes.

Newcastle Blast-furnace in Operation.

THE first production—upon a commercial scale—of pig iron from native ore in South Africa took place at the Newcastle Iron Works, Natal, on Saturday, June 19th, the first tapping being made just after twelve noon. The furnace had been blown in early on the preceding day.

The history of the Newcastle blast-furnace has been very chequered. The company which started its erection ran short of funds just before bringing it to the producing stage, and there was a long period of unsuccessful attempts to obtain Government assistance or to raise money privately. After a year or so the Union Government passed an Act through Parliament providing for a bounty of 15s. per ton on every ton of pig iron produced from native ore, the bounty to taper gradually away so that at the end of eight years it would terminate; a similar bounty of 15s. per ton was also provided for each ton of iron and steel produced from such pig iron, the annual quantities of pig iron and iron and steel produced not to be less than 50,000 tons of each per annum. This encouraged the Union Steel Corporation, which has large steel works at Vereeniging, to consider the whole question of pig iron production favourably, and negotiations which took place resulted in the Corporation acquiring the Newcastle iron-works, including the uncompleted blast-furnace.

It was then found necessary to enlarge the blast-furnace so that the output would be brought up to the figure necessary to obtain the bounty. Also Mr. Holgate, manager, on coming out from England to take charge, found it necessary to introduce many alterations and additions to the works while bringing the furnace to the producing stage. There were, in fact, many delays so that during the past twelve months or so the approximate date for commencing production has been announced and then altered on so many occasions that not a few people began to express scepticism as to a start ever being made. However, a beginning has now been made, and with large stocks of all raw material on the ground, and future supplies in constant flow, and adequate quantities arranged for, it would seem that the Corporation's troubles are now about over.

The furnace, which is 70ft. high and has a capacity of 150 tons per day, has been constructed on most modern lines, and includes all the latest designs for the cooling of plates, &c. There are three hot blast stoves, and provision has been made for the erection of a fourth. The power plant consists of two Parsons steam turbines for generating electricity and one Belliss and Morcom set, and the blast equipment is supplied by two Allis Chalmers blowing engines—converted from air compressors—each of which will blow about 20,000 cubic feet of air per minute. The probabilities are that the Newcastle furnace equipment will very soon be augmented. It is understood, indeed, that the question of enlarging the capacity of these works has already received the serious consideration of the Board. The ore to supply the plant will be drawn from the Dundee district, where a very large body of good grade hematite ore has been opened up. Supplies at that point are estimated to be sufficient for some thirty years' consumption, and larger deposits are available within reasonable distance. It is estimated that the Kremdroai deposits, which will be developed when required, are immense. Mr. Stanley Kay, an English expert, who has thoroughly examined the deposit stated: "The reserves of iron ore, over 50 per cent. metallic iron, low in phosphorus and sulphur, and with not more than 10 or 15 per cent. silica, are sufficient to last sixty years, at least for a production of pig iron equal to 100,000 tons per annum for ten years, and 150,000 tons to 200,000 tons in subsequent years." The average yield of the ore is said to be 56 per cent. of metallic iron.

Primarily, the pig iron will be required to supply the Vereeniging steel works in the Transvaal, which are situated

about thirty-five miles from Johannesburg and within a few hundred yards of the large electric power station of the Victoria Falls and Transvaal Power Company, Ltd., from which the Corporation obtains the electric power necessary for the running of the whole plant, while adjacent to the steel works are the works which manufactures the fireclay, silica and magnesite bricks required for the steel furnaces, while the coal is supplied from the collieries of the Vereeniging Estates, Ltd., situated close at hand. Up to date the Vereeniging steel works have produced 140,000 tons of steel, which have been manufactured into the requirements of the railways and mines, farmers and industries generally throughout the Union and adjoining territories. Hitherto the steel output from Vereeniging has been produced from scrap. The plant consists of four Siemens open-hearth basic furnaces of 20 tons, 25 tons, 30 tons and 35 tons capacity respectively, and two 3½-ton Heroult electric furnaces. A Tropenas converter of 3 tons capacity, with its attendant cupolas, has been installed. The rolling mills consist of one 12in., one 15in. merchant bar mill, and 22in. three-high cogging and finishing mills, with the necessary reheating furnace, mechanical live roller conveyors, hot banks, modern hot saws and straightening machines and roll-turning lathes. The foundry is equipped for the production of both iron and steel castings with drying stoves and annealing furnaces. The works buildings are served by electric overhead travelling cranes and extensive sidings. The average monthly output for 1925 was over 1800 tons, and the present output is 2000 tons per month, which it is intended to increase to over 4000 tons per month. The construction of a wire works is proceeding rapidly on a site about a mile to the north of the main works and in the near future will be producing wire rods and wire of all kinds, high carbon steel for winding ropes, mild steel for fencing, and steel for concrete reinforcements. The number of employees at present is 838, of which 278 are white and 560 are natives. The works supply tube mill bars of high carbon steel, rails weighing 16 lb., 20 lb., 25 lb., 30 lb. and 45 lb. per yard, fish-plates, angles, flats, rounds, and square bar steel, steel castings weighing up to 6 tons each, crusher parts, engine parts, transmission machinery, skip wheels, truck wheels, &c. Large quantities of steel have been supplied for the construction of bridges, grain elevators, and other works.

While the Newcastle blast-furnace is the first to be started for commercial purposes in South Africa, some 2000 tons of pig iron were produced some years ago from a small furnace, but this was entirely for the purpose of ascertaining, by a large size experiment, the suitability of South African ores for the production of good quality pig iron. Mr. Holgate, the manager, it may be added, was formerly works manager of the Bengal Iron and Steel Company.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

On the week there has been little, if any, change in the industrial situation in the Midlands and Staffordshire. If anything, the difficulty of securing raw materials with which to carry on the works has increased, but by dint of perseverance, the paying of higher prices, and the use of continental material, most of the works continue in limited operation. The iron and steel market is stagnant. Producers have little to sell, and the consuming branches have been thrown so completely out of gear, with few exceptions, that there is no great eagerness to buy. In no department of the market is there any serious attempt to initiate post-strike dealing. Producers are in many instances stipulating that buyers shall bear any increase in transport costs which may result from the present industrial upheaval.

Steel.

Little business is being done in steel, except in the structural department, where all available supplies are rapidly taken up. Belgian joists and bars are being used to help out native supplies. The small steel plants in operation are asking and receiving better prices for their output. In justification for their demand for higher rates, they point to the increased cost of production. For prompt deliveries of sections, as much as £8 2s. 6d. to £8 5s. is asked by re-rollers. Billets cannot be obtained from home sources, the supplies being exhausted, and the situation on the Continent is being anxiously watched. The reluctance of Belgian houses to quote is attributed in some measure to the increased demand for foreign finished steel, owing to the diversion of orders from this country. Constructional engineers continue to receive inquiries for bridge building, railway station reconstruction and numerous erections or enlargements of factories and business establishments. The number of orders placed for cranes and various types of auxiliary plant for steel works indicates that some enterprise is being shown by steelmakers in the renovation and improvement of machinery in preparation for the anticipated autumn activity.

Pig Iron.

In the Midland district no pig iron is being made' and the only native material available is forge pig iron, or inferior qualities ordinarily of little use in the foundry. Special prices are paid for anything which is capable of foundry use. Business can hardly be said to be subject to any definite level of values now. Supplies are at the moment chiefly derived from the North-East Coast and Scotland. Cleveland No. 1 is still available, but No. 3 appears to have been exhausted. Some Scotch furnaces still operating have sent consignments into this district, which have been very welcome in relieving the difficulties of the foundries. Scotch iron is quoted at about £4 3s. at furnaces, to which has to be added 18s. 6d. transport costs to this district. Cleveland No. 1 foundry is about £4 7s. f.o.t., or about £5 2s. delivered here. An odd lot of Derbyshire No. 4 recently changed hands at £4 10s. The only iron offered from Northamptonshire is of high-silicon content, the quotation being £4 2s. 6d. at furnaces. East Coast hematite is offered at £3 17s. or less for mixed numbers.

Finished Iron.

Finished iron is to all intents and purposes off the market. Business for some weeks past in this district has consisted almost entirely of the sales of stocks, individual firms having realised some thousands of pounds by the disinterment and collection of bars, &c., which have been held for a considerable time. At date no finished iron is being turned out in the South Staffordshire district. A very few Lancashire Crown bars are being offered at a premium of 20s. or more. Belgian bars are being imported for nut and bolt and hurdle making.

Galvanised Sheets.

Sheet mills in the Black Country are operating with coal recovered from the mounds, and, on account of the costly production and the promise of quick delivery, are making as much as £17 10s. for corrugated sheets of 24 gauge. This price is, however, about £1 in excess of the recognised standard. Orders coming to hand indicate activity in this branch of the trade for the rest of the year. These mills depend almost entirely on Belgium for their sheet bars, and under the stimulus of an active demand the price has stiffened to £5 15s. There is some concern at the moment as to the consequences of the strike which is paralysing the port of Antwerp. The large sheet demand has given an opening to Germany, which is able to supply close-annealed sheets of 18 gauge at £8 2s. 6d. delivered here. These sheets are largely used in various Birmingham industries, and it is considered likely that the business will to some extent be retained after the end of the coal strike.

Scrap.

Scrap selling is entirely suspended for the present, steel works and others declining to receive delivery. Large tonnages of scrap *en route* have had to be unloaded and stored at considerable cost until they can be delivered.

Flood Menace at the Pits.

Whether many of the mines in the West Midland area will suffer a similar fate to that of the New Hawne, Witley and Corngreaves pits, which were flooded out during the 1921 strike, will be decided within the next two or three weeks. The financial position of the Old Hill mines drainage scheme became so serious that the colliery owners were recently called together to consider ways and means of keeping the pumping plant at work. They have undertaken to provide the necessary income to keep the pumps at work until July 31st, but what may happen at the end of the month largely depends upon whether a settlement of the strike has been effected or not. It is generally conceded that the mining industry is declining in this locality, and for this reason it is regarded in some quarters as doubtful whether the owners will make additional sacrifices to maintain the pumps at work. The importance of the drainage scheme may be gathered from the fact that the average quantity of water drawn by the pumps at the Old Hill Mines Drainage Committee's stations and the pits is 4,000,000 tons, or 900,000,000 gallons per year. Furthermore, this is only sufficient to keep the water at its present level, it being impossible with the present plant to reduce it. Should the colliery owners at the end of the month feel it necessary to decline to provide the income for the continuation of the operations, the whole of the mines, numbering a dozen, would in a few days be completely flooded. The closing of the collieries would have a disastrous effect. Not only would some thousands of miners be thrown idle, but an incalculable injury would be done to other industries. Local industrialists rely to a large extent upon the coal produced in their area because it is not only cheaper, but has special properties which enable them to obtain best results in the manufacture of certain goods. It is to be hoped therefore, for the sake of the future industrial prosperity of the district, that some steps will be taken which will prevent any further curtailment of the life of the mines.

Railway Orders.

Additional rolling stock business continues to reach the Midlands, the latest addition being an order for four articulated trains, comprising thirty-two coaches in all for the London and North-Eastern Railway Company. The work is to be executed by the Midland Railway Carriage and Wagon Company, Ltd., Birmingham.

Coventry's Position.

There has been no change for the better in the Coventry motor engineering industry; indeed, judging from the unemployment statistics, things are getting decidedly worse. There is no restriction in electric power, but essential materials become harder to obtain, and the lack of one commodity and another holds up departments, the cumulative effect being to destroy the balance of the shops and increase the difficulties of motor engineering firms.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE iron and steel markets in the Lancashire area have been watching with some interest the latest developments in the coalfields of Lancashire and Cheshire, but so far nothing has happened to justify even faint hopes of an early settlement of the coal-mining dispute. The owners' terms, which were posted last week-end, guarantee, until the end of September, the same rates of wages as before the dispute for an eight-hour day, wages thereafter to be fixed by ascertainment of the work of the two preceding months. The pits in the two counties were reopened on Monday of this week, but up to the time of writing it is stated officially that no men have reported for duty. The iron and steel industries are thus apparently as far off as ever from being able to resume operations. Reserves of fuel and iron and steel materials are fast being depleted, and the effect on the engineering industries leaves nothing to be imagined. Local constructional engineering firms, as has already been pointed out, were able in the early period of the stoppage to pick up supplies from all conceivable sources to enable them to carry on to some extent, but those firms which are largely restricted to British materials are finding the critical famine period steadily growing nearer. Many other branches of engineering are closely affected by the fuel shortage, and short-time operations are being resorted to by textile machinists and other firms on an increasing scale. Heavy electrical engineering continues to be about the busiest section of the engineering industry, and the Metropolitan-Vickers Electrical Company, Trafford Park, has a number of important contracts in hand, some of them relating to substantial hydro-electric schemes in New Zealand, Africa and South America.

Non-ferrous Metals.

The position of the non-ferrous metals is firm generally, and in some sections quite a good business has been put through during the past week. In the case of copper, both here and in the United States, there has been a noticeable improvement in the volume of buying, some of it speculative, the result being an important advance in prices. Mainly through heavy buying on American account, and, of course, the strong statistical position of the metal, tin has acquired additional firmness, and the view is that this condition is likely to continue for the time being, the position at the time of writing being well maintained. Present prices indicate a net advance of nearly £20 per ton since the lowest point of the sagging movement was touched, at the beginning of last month. Spelter is somewhat better than it was a week ago, and the position of this metal is believed to be a sound one. Although good supplies of lead are available holders are maintaining a strong hold on the market, and present quotations represent a fairly substantial advance over the prices quoted last week. At the moment the demand for continental users is rather less active, as is also the consumption in the United States, whilst in this country the demand has naturally been seriously affected by the general industrial situation.

Iron.

The position of the iron market is essentially uninteresting and, with little or nothing to offer so far as pig iron is concerned, sellers are not showing very much interest in things. Hematite is now practically the only iron that is obtainable for early delivery, offers of Scottish on this market having come to an end, and Midland Counties makes being still off the market, as they have been for some weeks now. This week East Coast hematite is quoted at about 93s. 6d. per ton, delivered Manchester or equal, which represents a rise of 1s. per ton since last report. Scottish makers are now only quoting for forward delivery, and high rates, varying from 100s. to 101s. per ton, delivered, are being asked. It is doubtful, however, whether much actual business is being done on those terms. Fair stocks of manufactured irons are still held by some merchant firms, although these are very much less than they were at the beginning of the general strike, no additions having been possible to make up for the call upon them during the past ten weeks. At the moment, however, the demand is poor. For delivery in the South Lancashire area, Crown bars are still offered at £11 10s. per ton, and second quality bars at £10 5s.

Steel.

Apart from one or two re-rolling mills one hears also of an occasional rolling mill in operation, but usually they are only able to work for short periods, and no essential difference is made to the position as regards supplies. The result is that more and more users are turning to continental steels. One Lancashire firm which has been able to run a re-rolling mill has been selling small bars at from £9 5s. to £9 10s. per ton delivered. The minimum prices for joists and ship-plates remain at £7 7s. 6d. and £8 2s. 6d. per ton, while boiler-plates are quoted at about £11 10s., although these figures, under the circumstances, must be regarded as nominal to some extent, for there are still firms which are not disposed to do forward business on that basis. The port strike at Antwerp proved to be short-lived, and thus a formidable obstacle in the way of deliveries of continental materials is out of the way. It is still the case, however, that periods necessary for delivery of these vary a good deal, up to eight weeks, depending upon the nature of the material and the position of the individual makers, not being uncommon. Although nominally little changed from last week, quotations depend to a great extent upon the size of orders and other factors, especially in the case of semi-finished materials, which are becoming very scarce. Plates range from about £5 17s. 6d. to £6 7s. 6d. per ton, delivered Manchester, for cash against documents, joists at £5 12s. 6d., sections at about £6, and steel bars at £5 16s. to £5 17s. 6d. per ton. There is not much trade reported in galvanised sheets, most of the works being closed down. For the usual Indian specifications for forward delivery quotations are from £16 10s. to £16 15s., and about £1 more for prompt, while wasters, stocks of which makers are endeavouring to clear, are being offered at about £1 per ton less than primes.

Scrap.

The demand for both iron and steel and non-ferrous metal scrap is very poor, and in the case of the former prices are purely nominal. For graded qualities delivered to consumers' works, braziery copper is quoted at £50 to £51 per ton; clean light copper, £57; zinc scrap, £24 to £25; lead, £28 10s.; cast aluminium, £84; and best selected gun-metal scrap at £52.

Manchester Association of Engineers.

On Thursday, the 8th inst., a large party of members of the Manchester Association of Engineers, accompanied by the President, Sir Benjamin Longbottom, paid a visit of inspection to the English Electric Company's works at Preston. After luncheon at the Victoria Hotel as guests of the company, the members visited the different sections of the works, including the electric shop, the lamp works, and the car and locomotive departments. The traction work includes the manufacture of small motors for tramcars and railless vehicles, and the larger motors for large locomotives. It also includes the manufacture of control gear of all types, such as the standard controller for tramway work and the controls for multiple unit coaches and large electric locomotives. The smallest motor made up to date is about 10 horse-power, and is used for mining type locomotives, whilst the largest motor is 450 horse-power for locomotives for the Montreal Harbour Commissioners. The largest alternator in the shops at the present time is a 22,000 kilovolt-ampère machine, for the hydro-electric installation of the Tata Power Company, the water wheel for which is being made at the company's Rugby works. After the inspection the party was taken to the Dick, Kerr Club, situated in Ashton Park. During tea a vote of thanks was accorded to the company, on the motion of the Association's President, to which Messrs. Fairburn and le Marechal responded.

New Engineering Works near Manchester.

I was present on Saturday last at the official opening of the new works of Henry Simon, Ltd. These works are pleasantly situated in rural surroundings at Cheadle Heath, well away from the industrial areas of Manchester and Stockport, and cover an area of about five acres. They are equipped on the most modern lines in accordance with approved engineering practice, and there is ample room for further extensions. The shops have been laid out with a view to securing the maximum production with the minimum handling, and work is carried out under ideal conditions, all shops being exceedingly well lighted and airy. The works are electrically driven throughout. The front block of buildings comprises commodious managerial, commercial and drawing-offices, &c., together with a large and well-equipped canteen for the office staff and workpeople. Ample opportunities for recreation are provided. The playing fields include hard tennis courts, a bowling green, cricket and football fields, and even a miniature golf course. These facilities are naturally much appreciated, and, I understand, already the various clubs have a large membership. The opening took the form of a social gathering, at which about 800 people were present. The guests were received by Mr. E. D. Simon, chairman of the firm, and Mrs. Simon. The afternoon was chiefly devoted to an inspection of the works and games. After tea the opening ceremony was performed by Mrs. Simon. Mr. Simon, who presided, said the new works were built mainly with a view to the export trade. The directors recognised that they had taken a risk in investing so much money in a works with prospects of keen continental competition ahead, but they were confident that, with the support of an excellent staff and a first-class body of British workmen, they would be able to hold their own and expand their trade. The chief products of the works will be flour-milling machinery and conveying plants.

BARROW-IN-FURNESS.

Still Waiting.

The iron and steel industries in the North-West district are still waiting for the coal trouble to end, and in the meantime the stocks are gradually being cleared in small parcels to various customers. There has been a shipment of pig iron to Antwerp, and this was accompanied by some iron ore for the same port. All the ironworks are still idle, and in the steel departments very little indeed is being done. The hoop works at Barrow were held up, but this was not on account of fuel but billets, which come from abroad. The iron ore mines at Hodbarrow are still working, but there is not much ore being brought up, and the Roanhead Mines are also employing a certain number of men, but there is little business. The fuel question has become a serious one in this district, and during the last week it has been necessary to import coal. Prior to the strike Vickers held large stocks, but they have dwindled down. The same remark applies to the local power station. After much discussion at the Barrow Town Council, it was decided by a small majority to purchase foreign coal. Between four and five thousand tons have arrived from German ports and more is expected.

SHEFFIELD.

(From our own Correspondent.)

A Few Plants Re-started.

IT is possible this week to record a slight improvement in the industrial position. The heavy departments and others which are large consumers of coal cannot continue working on the expensive fuel that is now available, but an increased supply of continental coal has enabled the special steel departments to continue working, and the general position, indeed, has so far steadied that some plants have been re-started. There is a reduction of several hundreds in the number of registered unemployed. Of course, enormous damage has been done to the steel trade, but much of it may still be made good if an early settlement can be reached in the dispute. There is every reason to believe that but for the stoppage the steel trade would now be in a better position than for a long time. Inquiries are arriving in quite a satisfactory manner, and manufacturers are doing their best to temporise with them and to keep them "in the running," though the great trouble, of course, is to give a definite quotation or guarantee delivery. Buyers are displaying a sympathetic attitude, and a good deal of trade may be expected to develop when industry again gets unrestricted supplies of power. Works have made a much better effort to carry on than during the last dispute in 1921, which not only indicates that trade is better, but that prices are more satisfactory. Five years ago firms decided that it was not worth their while to put up a fight, and the present maintenance of work with an increase in costs suggests greater virility. Departments at several of the large works are periodically re-starting as circumstances justify.

Coal Supplies.

Nearly 60s. a ton is the price being paid for continental coal, but with the exception of the Silesian product, the quality is not good, and mixtures have to be made to get satisfactory calorific results. Dutch coal has proved valuable for the production of coke at the Derbyshire ovens. Sheffield Electric Supply Department, which has maintained an excellent service throughout, has already spent £2200 in the purchase of special lots of coal from local collieries and outcrop workings, and, in addition, 9000 tons of coal have been imported from Silesia. Outcrop coal, of which there is a very good supply in this district, is keeping several industrial plants working. Generally, it is poor stuff, but a fairly satisfactory result is obtained when it is mixed with better quality fuel. The workers of these seams are largely miners, and there is a strong tendency to profiteer. Up to 40s. a ton is being asked for this coal, even for the very small stuff which contains a high percentage of dirt. At least one Sheffield firm, the Laycock Engineering Company, Ltd., of Millhouses, has been able to carry on as usual by converting its boilers from coal to oil firing. A representative of the firm states that the conversion was made during the last coal stoppage, and that it was a simple matter this time to effect the transfer. Burning oil has proved more expensive than burning coal, but the firm preferred to make the change rather than throw out of work between 200 and 300 men. The majority of the gasworks in this district have been able to get supplies of coal from various sources, and in the case of the undertaking in Sheffield, which supplies large quantities for industrial purposes, there has been no interference with the supply and no apparent lowering of quality.

Engineering Orders.

I referred last week to the useful orders that are being placed by the London and North-Eastern Railway Company, and to the contract for coaches given to Cravens, Ltd., of Sheffield. Cammell Laird and Co., have now received at their Nottingham works an order from this railway company for two additional Sentinel-Cammell coaches and thirty-four all-steel luggage brake vans. Cammell Laird's associated company at Birmingham has also received an order for four articulated trains, comprising thirty-two coaches in all. The placing of these contracts means, of course, useful work for the Sheffield steel railway plants of Cammell's. The tender of Robert Dempster and Sons, Ltd., amounting to £38,850 for a three-lift gas holder, has been accepted by Chesterfield Council.

Plate and Cutlery.

The plate and cutlery trades are only being kept going with difficulty. Orders from shopkeepers are coming through in meagre fashion, owing to the decreased purchasing power of the general public following the trade upset. Wholesale and retail houses do not consider the time suitable for replenishing their stocks. In the stainless branches there is some activity, largely traceable to the enterprise of manufacturers in putting new and attractive lines on the market at popular prices. The fancier types of wares are being pushed for Dominion sales, and are meeting with considerable success. Price cutting still prevails, and it is not proving an easy matter to organise sales at a profit. Firms have effected some drastic economies of late in an effort to minimise the troubles that have been forced upon them by the coal trade dispute, for the lighter trades, naturally, are not continuing work on the pre-dispute costs. The returns of the cutlery exports for last month are satisfactory on the whole, though they are slightly down on the figures for June last year. The imports of cutlery, hardware, implements and instruments are down on the previous June figures by over £1,000,000.

Rival Transport Systems.

Chesterfield is one of the municipalities which has had to come to a decision on the road transport question, and has resolved to install trackless trolley vehicles in place of electric trams. To have used petrol omnibuses, it is estimated, would have involved an annual loss of £615, but with trolley omnibuses it is calculated that there will be a profit of £4556. A tender of £23,947 has been accepted for converting the overhead equipment, new turning circles, &c., and supplying single-deck trolley vehicles.

A New Coal Area.

The discovery of a rich supply of coal at a depth of about 3600ft. at Doddington, near Lincoln, has led to some interesting views being expressed by Professor W. G. Fearnsides, Professor of Geology at Sheffield University. He states: "The highest coal proved at Doddington is, I think, of more than 800 yards in depth, and they have proved coal measures down to 1200 yards. The structure of the area around Doddington is totally unknown, and it is improbable that the coals would be exploited until the price of coal, in terms of other commodities, is 50 per cent.—perhaps 100 per cent.—greater than at present. If £2 were offered at the pit mouth for all coal that came up at Doddington, I think the engineers of the present time would probably be willing to undertake sinking at Doddington. That is the difficulty. Anybody who sinks any shaft on the east side of the Trent at any point north of Newark, must expect to have to pass through at least 500 yards of heavily watered ground. This mass has got to be dealt with by freezing, cementation or some other expensive process. Apart from this new extension, the Notts, Derbyshire and Yorkshire coalfield certainly contains a greater reserve of coal than all the rest of England. It is the British coal reserve, and all that we get beyond the Trent is that much to the good. It is part of an original coalfield. All that we are doubtful about is whether this coalfield is a simple saucer, or whether Doddington is broken from the well-known coalfield by a development of more complicated form. To explore it there ought to be put down a net of bore-holes located at the corners of equilateral triangles, which will cost from £5000 to £10,000 each. Each should be situated about 2 miles apart, and then I think something might be got. There is no doubt about it; there is coal at Doddington and Crosby."

Death of Mr. H. Lawson Whalley.

Much regret is felt at the death of Mr. Henry Lawson Whalley, managing director of the Hope Foundry, Leeds, and a director of Fairburn, Lawson, Combe, Barbour, Ltd., which occurred suddenly at Harrogate on July 4th. The flax and linen trades of Yorkshire and Lancashire owe much to the work of Mr. Whalley and his predecessors, for it was at the Fairburn Wellington Foundry that machinery was manufactured which it can be said "made" the flax and linen trade. Mr. Whalley, who was seventy-one, had, during his business career, travelled widely, and he had an intimate knowledge of the industrial conditions of many European countries. His visits to Russia each year up to the outbreak of war and his many visits to America, had given him a still wider experience.

NORTH OF ENGLAND.

(From our own Correspondent.)

No Sign of Resumption.

How long will the coal stoppage last? This question is exercising the minds of everybody concerned in the industrial world in the North of England. It is confessed that the end is nowhere in sight. Indeed, some pessimists consider that the pits might remain closed to the end of the year. It is to be hoped that that fear will not be realised, for in such an event many collieries might go out of business altogether. The fact cannot be overlooked, however, that foreign producers are securing the bulk of the autumn trade, and that when operations are resumed, the markets lost through the stoppage will be exceedingly difficult to regain. The pits in Northumberland and Durham reopened on Monday on the new terms of the owners, but the miners did not return. An eight-hour day and a reduction broadly of 10 per cent. in wages offered by the Northumberland and Durham coalowners is generally regarded as reasonable from the men's point of view, having regard to the specially disadvantageous conditions of the industry in this area. Indeed, the owners are far more likely to make a loss than a profit. As showing the exceptionally unfavourable conditions prevailing, it may be pointed out that while in the Eastern district and Somerset the returns for January–March showed a credit balance apart from the subsidy, in Northumberland and Durham there was a loss, including the subsidy.

The New Terms.

On general lines, the terms for the two counties are similar; but, of course, there are differences in detail and conditions. The Northumberland terms are that the pits will be open to such workmen as may be required on a payment of 80 per cent. addition to the basis rates, and on condition that all classes of men employed underground shall work eight hours per shift plus one winding time, and with restricted drawing hours. Surfacemen's hours are to be the same as those prevailing in 1919 before they were reduced to 46½ hours per week. The percentage additions to pieceworkers which were granted for the reduction of hours, are not to apply whether they have been merged in the piece prices or not. There will also be paid a subsistence allowance to adult low-paid day-wage workmen of 6s. 9½d. per shift, in addition to the previously existing provision of house or rent allowance, and coal to such workmen as are entitled thereto under the old arrangement. These conditions apply until September 30th, 1926. The Durham coalowners' terms differ in minor details, the main differences being 89 per cent. instead of 80 on the basis rates, and 6s. 8½d. instead of 6s. 9½d. subsistence allowance. Mr. W. Straker, secretary to the Northumberland Miners' Association, describes the new terms as being impossible of acceptance, and the owners' suggestion of a joint conference has been refused.

Cleveland Iron Trade.

The irresistible pressure of circumstances is driving prices ever upwards. There are obvious dangers in continued inflation, but events are too powerful. On the one hand, production is still dwindling, and, on the other, the cost of production steadily rises. Fuel is reaching almost a prohibitive price. Home supplies are almost exhausted, and the foreigner is exploiting the situation by forcing prices to impossible levels. It is worthy of note that foreigners will not sell coal and coke in small quantities. In some cases, in order to secure early needed supplies, consumers have to make contracts with overseas firms for delivery over several months. In all branches of the Cleveland pig iron trade transactions are necessarily on a very limited scale. Little material is available for prompt business, and both buyers and sellers are markedly disinclined to negotiate ahead until some indication appears as to the level at which prices are likely to settle when home fuel supplies are once more forthcoming. With sources of supply of Cleveland pig iron well-nigh exhausted and imports of foreign substitutes held up by the dockers' strike at Antwerp, consumers of iron here experience some difficulty in obtaining supplies. Since my last letter prices have advanced by 3s. 6d. per ton, No. 1 Cleveland foundry iron now being 90s., No. 3 G.M.B. 87s. 6d., No. 4 foundry 86s. 6d., and No. 4 forge 86s., all for home use; 6d. per ton more is still asked in the case of iron for export, but there is no business passing.

Hematite Pig Iron.

East Coast hematite pig iron continues in good supply. Unsold stocks are still large, but makers are somewhat less keen to book orders at the comparatively

low recognised market figures, and some surprise is felt that certain firms in the habit of consuming Cleveland pig iron are not making extensive use of hematite. Mixed numbers are quoted at 80s., and No. 1 quality at 80s. 6d. per ton.

Manufactured Iron and Steel.

There is an absence of new features of moment in the manufactured iron and steel trade. Good inquiries are still circulating, but actual business is far from extensive. Demand, which is almost entirely on home account, is met chiefly from stocks, which are now getting very low, and from the Continent. There is rather more demand for semi-finished steel materials, and sellers, anticipating an upward movement in prices, with increasing scarcity of supply, are inclined to hold off the market.

The Coal Market.

Now that the Eight Hours' Bill is in force, and the owners' terms are becoming well known among the men, operators eagerly await the outcome. There is a feeling that the men will slowly dribble back, and that after a week or two an increasing number will return. In the meantime, business remains suspended, and sellers hesitate to give the slightest indication of price.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE position in the shipbuilding industry is most unsatisfactory. As a matter of fact, both in respect to the amount of tonnage launched and the trade outlook, the six months just ended have been one of the worst periods in the history of the industry. During that time 80 vessels, of 158,552 tons aggregate, were launched, compared with 119 vessels, of 302,957 tons, in the same period last year. During the month of June last twelve vessels of 18,521 tons, were launched, compared with twenty-seven vessels, of 43,451 tons, in the same month last year. Of last month's launches, only two vessels were over 1000 tons:—The Plume, oil tanker, 8600 tons, built for the Vacuum Oil Company, London; and the Shropshire, twin-screw motor passenger and cargo vessel, 7500 tons, for the Bibby Steamship Company, Liverpool. Among the others was a twin-screw cargo steamer, 840 tons, for the North Coast Steam Navigation Company, Sydney, N.S.W. Some comparatively good contracts were reported during the past month, but the yards generally are short of work, while progress on the vessels on hand is decidedly slow. Work is held back through a shortage of steel and other materials, due to the coal strike.

Steel and Iron.

The situation in the steel and iron trades has not improved, and production is now practically at a standstill throughout this area. Most of the works which restarted after the collapse of the general strike have now been forced to close down, owing to a shortage of fuel. The annual holidays are now due, and in all probability they will be prolonged in many instances. So far as fresh orders are concerned the outlook is fair, as some firms report a steady inquiry and a fair accumulation of orders for delivery when the resumption of work takes place after a settlement of the coal strike. During the past few days inquiries have fallen off, probably owing to the firmer prices quoted. With the closure of Stewarts and Lloyds' Mossend Steel Works the production in this district has been brought almost to a complete standstill. The output of steel sheets is limited, and is easily absorbed, while some business is being done for forward delivery at enhanced prices. Bar iron makers have practically ceased operation until the end of the coal strike. Small lots of re-rolled steel are available, and are bringing good prices. The production of pig iron is discontinued, and, with a resultant scarcity of all brands, prices continue to appreciate.

Coal.

There has been no change in the coal trade in Scotland during the past week. While reports state that many miners are willing to return to the eight hours' day, there has been practically no response to the terms offered by the owners so far. Apart from foreign fuel, there is really nothing available for disposal, and even the foreign coal arriving is mostly to the order of either municipal or private consumers. From an industrial point of view, the price is prohibitive. The demand for house coal has fallen away, owing to continued warm weather. In some districts, however, difficulty is experienced in securing the ration allowance, and substitutes are being resorted to. Where supplies of coal are available, prices still range between 3s. and 3s. 9d. per cwt.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

EXCEPTING the actual passage of time, it would almost appear as if a settlement of the coal trade dispute were as far off as ever. In South Wales there is no development which gives any real hope of an early resumption of work. No one appears to look for a restart before August at the earliest, and it may easily be much later. The miners do not display a definite inclination to drift back to work on the coalowners' new terms, though many would undoubtedly be prepared to resume if they could do so without incurring the hostility of their fellow workmen. As it is, miners can be seen any day of the week going off on char-à-banc trips; nothing is heard about starvation, while the reports as to the miners' children are that they are better fed and in better health than they have ever been. Individual districts continue to pass resolutions against the conditions offered by the coalowners and the Executive Committee of the South Wales Miners' Federation has not in the least changed its attitude. This Committee met at Cardiff on Monday to consider the position, when it endorsed the action of its general secretary in declining to agree to the suggestion of the coalowners that there should be a joint meeting for the purpose of arranging terms for a resumption of work. It further urged the miners to stand loyally by the decision of the Miners' Federation of Great Britain not to return to work under the Eight Hours' Act. The position is, however, growing increasingly serious, and that is realised by all reasonable members of City and Urban Councils and Boards of Guardians. The costs of relief are piling up and creating an abnormally heavy burden for the ratepayers. The situation was referred to at a meeting of the Cardiff City Council on Monday, when a resolution was passed that the Lord Mayor should invite the coalowners and miners' leaders to consider the advisability of having an informal conference. Grave doubts are entertained whether the Lord Mayor will be successful in view of the fact that the coalowners' invitation to the men's leaders has already been declined.

Import and Export Trade.

There is, of course, practically no export trade, while imports are on a rather modest scale compared with normal periods, except that petroleum imports have recently been materially higher than usual at Swansea. The quantity of foreign coals coming in is expanding almost daily. The Great Western Railway Company has purchased 50,000 tons of American coals, and one cargo of 7000 tons is now being discharged at Newport. The ss. Pearlmoor, of 7000 tons, was due to arrive at Barry on Wednesday, while the ss. Baron Fairlie, of 8500 tons, is expected at Cardiff shortly. Several cargoes have come to Swansea with German coals, being part of an order of 10,000 tons arranged by Messrs. Richard Thomas and Co., while the ss. Corpath has docked with a cargo of about 2200 tons of German coal. Other cargoes of continental coals have either arrived or are due, and some of them have, from all accounts, given satisfaction, though in others the quality is perhaps not all that could be desired. The fact is that foreign producers are giving more attention to the quality of the coals which they are shipping to other markets in which there is a better chance of their maintaining a good hold after the troubles in this country are over. They realise that the demand from this country is at the best only temporary. Since the stoppage of work at the mines in this country over two and a-half million tons of American coals have been arranged for discharge at United Kingdom ports. One firm in touch with the Government authorities is understood to have chartered recently fifty steamers, while chartering of tonnage continues in readiness for loading up to the early part of next month. It is not unlikely that the order of the Egyptian State Railways for 150,000 metric tons of locomotive coals for shipment during August and September will be placed for American coals, in view of the continuance of the stoppage of work in this country. Tenders for this business have to be at Cairo on Saturday, the 17th inst. A few local firms may tender, but they cannot give a guarantee of delivery, which must of necessity prejudice their chances of getting the business for South Wales coals.

Coalfield Items.

The conditions in some parts of the coalfield have not been quite so free of incident as formerly. During last week-end the safety men of the Blenhirwaun Colliery, owned by the S.R. Anthracite Colliery Company and situate near Llanelly, were called out by a district committee of the South Wales Miners' Federation. About twenty safety-men are involved, and the allegation is that these men had been employed to fill coal from the dumps into trucks for commercial purposes. The allegation has been denied by the manager of the colliery, where the work of keeping the pit from flooding is now entirely done by the colliery staff. Similar trouble was experienced on Monday in the Ogmore Vale, where both miners and their women folk stopped safety-men from getting to their work. A deputation from the demonstrators interviewed the managers of the Ocean and Wyndham collieries, and, as a result, the latter agreed to dispense with the services of those members of the Miners' Federation employed on safety-work and only to carry on with members of the Colliery Examiners' Association. In the Heolycyw District there was also trouble on Monday. Feeling was caused by the action of fourteen members of the Miners' Federation returning to work in defiance of instructions. Later in the day the men's officials interviewed the fourteen men individually, and, as a result, all but one agreed not to return to work.

Miners at Work.

There are about fifty men working at the Brynna Colliery, near Llanharan, and the terms on which they are employed are stated to be an eight-hours day, no 14·2 per cent. given when miners' hours were reduced from eight to seven per day, with a wage rate of 45 per cent. above the 1914 standard and a bonus of 5s. a week per man. This colliery normally employs 400 men.

Reduced Wages Preferred.

A mass meeting of the Vale of Neath—anthracite area—decided on Tuesday not to accept the terms offered by the owners, but recommended acceptance of a wage reduction with a seven-hour day.

Colliery Examiners and Eight-Hour Day.

The Executive Council of the South Wales Colliery Examiners' Association at Cardiff on Saturday considered reports which had been received from some districts where it was stated that instructions had been issued to the examiners who had been kept on as safety-men to work more than seven hours per day. It was decided to issue instructions to Association members that under no circumstances should any variation of the hours be considered at present. It was pointed out that the existing conditions of work had been entered into by agreement as the outcome of negotiations between the employers and the Association, and it was understood that steps would now be taken to secure a joint meeting between the representatives of the Association and the coalowners' organisation, so that the matter could be dealt with.

Colliery Development.

Immediately the coal trouble is settled the new Taff-Merthyr Colliery, Trelewis, will start coal winding. It is expected that this undertaking will have an output of 1000 tons per day, and provide employment for about 2000 men when in full operation. The company intend erecting 600 houses for the men on the Gilfach Main Estate. Plans for the first 100 houses have been approved.

Tin-plate Trade.

The conditions show no material change. Imported coal is now being used in the tin works, but complaints are heard that in quality the fuel is inferior to Welsh. The business being done is mainly in stock plates at prices up to 26s. basis I.C. f.o.b. works port, but for supply after the termination of the coal stoppage 20s. 3d. has been paid.

Bar Mills Recommence.

The bar mill at Cwmfelin Works, Swansea, was restarted on Monday, and arrangements were being made for a resumption at the Grovesend Works, Gorseinon.

LAUNCHES AND TRIAL TRIPS.

CITY OF BATH, steel steamer; built by William Gray and Co., Ltd.; to the order of the Ellerman Lines, Ltd.; dimensions, 408ft. 6in. by 52ft. 2½in. by 30ft. 8in. Engines, quadruple-expansion, 21½in., 30½in., 45in. and 66in. diameter by 48in. stroke, pressure 265 lb.; constructed by the builders; trial trip, June 15th.

FIRBY, steamer; built by William Gray and Co., Ltd.; to the order of the Ropner Shipping Company, Ltd.; dimensions, 402ft. by 55ft. by 28ft. 9in. Engines, triple-expansion, 26in., 43in., 71in. diameter by 48in. stroke, pressure 180 lb.; constructed by the builders; trial trip, June 24th.

PLUME, oil tank vessel; built by Lithgows, Ltd., of Port-Glasgow; to the order of the Vacuum Oil Company, Ltd.; dimensions, 460ft. by 62ft. 6in. by 36ft. 6in.; 12,300 tons deadweight. Engines, inverted, direct-acting, triple-expansion; pressure 220 lb.; constructed by David Rowan and Co., Ltd., launch, June 24th.

ORESTES, motor ship; built by Workman, Clark and Co., Ltd.; to the order of Alfred Holt and Co.; dimensions, 459ft. by 58ft. by 32ft.; 8000 gross tonnage. Engines, twin sets of eight-cylinder Burmeister and Wain four-stroke Diesel; constructed by the builders; trial trip, June 25th.

GEORGE LIVESEY, single-screw steam tug; built by Harland and Wolff, Ltd.; to the order of South Metropolitan Gas Company, Ltd.; dimensions, 83ft. by 21ft. by 10ft. 6in. Engines, compound, surface-condensing, 18in. and 38in. diameter by 27in. stroke; constructed by the builders; handed to owners, June 26th.

ALMEDA, passenger and cargo steamer; built by Cammell Laird and Co., Ltd., to the order of the Blue Star Line; dimensions, 510ft. by 68ft. by 37ft. 3in. Engines, Parsons' combined impulse and reaction type turbines, pressure 200 lb.; constructed by the builders; launch, June 29th.

AMBROSIO, shallow-draught oil tanker; built by Harland and Wolff, Ltd., at Belfast, to the order of Andrew Weir and Co.; dimensions, 315ft. long by 50ft. broad; gross tonnage 2360. Engines, twin-screw triple-expansion, 1100 horse-power, pressure 180 lb.; constructed by the builders; trial trip, July 7th.

FREDERICK S. SPIERS MEMORIAL.—Many friends and associates of the late Mr. Frederick S. Spiers are desirous of establishing a memorial which will serve to remind future generations of the valuable services he gave to science and the humanities, and which will provide an opportunity for those who knew him to express their personal appreciation of his work. It has been suggested that it should take the form of a memorial lecture, to be paid for out of the interest on the fund and to be given at intervals, to be decided later, under the auspices of the Faraday Society. A committee to promote this appeal has been formed, and the following have consented to serve on it:—Inst. Comdr. T. Y. Baker, R.N., Mr. J. E. Barnard, F.R.S., Sir W. H. Bragg, K.B.E., F.R.S. (chairman), Professor F. G. Donnan, F.R.S., Professor C. L. Fortescue, Sir Robert Hadfield, Bart., F.R.S., Mr. R. L. Mond, the Hon. Sir Charles Parsons, K.C.B., F.R.S., Miss M. Parsons, Major C. E. S. Phillips, Professor Alfred W. Porter, F.R.S., Professor A. O. Rankine, and Mr. R. S. Whipple. Contributions should be sent to the assistant honorary secretary, Miss M. Parsons, at the offices of the Faraday Society and the Institute of Physics, 90, Great Russell-street, London, W.C. 1.

THE G.E.C. SPORTS.—The seventh annual sports meeting of the General Electric Company, Ltd., was held on the firm's London sports ground at Preston-road, Wembley, on July 3rd. As is customary in the G.E.C., great rivalry existed with regard to the destination of the four challenge cups which are open for competition to "All works and branches of the G.E.C.," but there was no mistaking the popularity of the dual success gained by Mr. D. E. Duncan, who took a pair of the cups to the Glasgow branch, one being the "Harold Hurst"—100 yards flat race—and the other the "White"—quarter-mile flat race. Of the remaining two, the "Hugo Hirst" three-quarter-mile relay challenge cup was retained by the London team, while the "A. H. Railing" cup for the half-mile was gained by Mr. B. Hall, of the Salford Electrical Instrument Works, Manchester. In addition to these trophies there are several cups open to the purely London establishments of the company, and they were won as follows:—Men's tug of war—the "Byng"—and the high jump—the "Railing"—both by the Express Lift Works; fire brigade competition—the "Fletcher"—by the head office; the ladies' relay race, by the research laboratories; the three-quarter-mile relay race and one mile flat race—the "Ernest Wilson"—by Fraser and Chalmers Engineering Works. After the events were concluded the prizes were distributed by Mrs. Railing, wife of Mr. M. J. Railing, director and general manager of the company. The remainder of the evening was devoted to dancing. In the fire brigade competition open to the London establishments of the G.E.C., head office completed the three separate drills in the excellent time of $74^{3}/_{10}$ sec., a fraction of a second in front of Fraser and Chalmers Engineering Works team. Osram Works, Union Works, and Research Laboratories also competed, the first of these three having the third best time. In the third drill, a one-man affair, one of the London staff, Mr. A. Newman, by finishing in $9^{1}/_{5}$ sec., established a record for the G.E.C., if not for the London Private Fire Brigades' Association.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home.	Export.
	£ s. d.	£ s. d.
(2) SCOTLAND—		
Hematite	4 0 0	—
No. 1 Foundry	4 8 0 to 4 10 0	
No. 3 Foundry	4 3 0 to 4 5 0	
N.E. COAST—		
Hematite Mixed Nos.	4 1 0	4 1 0
No. 1	4 1 6	4 1 6
Cleveland—		
No. 1	4 10 0	4 10 6
Silicious Iron	4 10 0	4 10 6
No. 3 G.M.B.	4 7 6	4 8 0
No. 4 Foundry	4 6 6	4 7 0
No. 4 Forge	4 6 0	4 6 6
Mottled	4 5 6	4 6 0
White	4 5 6	4 6 0
MIDLANDS—	(*Nominal: none on offer.*)	
(5) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 10 0	
,, Forge	2 16 0 to 2 17 0	
(3) Derbyshire—		
No. 3 Foundry	3 7 6 to 3 15 0	
Forge	3 2 0 to 3 5 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 8 6 (*a*); 4 12 0 (*b*); 4 16 0 (*c*)	—

MANUFACTURED IRON.

	Home.	Export.
	£ s. d.	£ s. d.
SCOTLAND—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—	(*Prices nominal.*)	
Crown Bars	11 5 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home.	(7) Export.
	£ s. d.	£ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 7 6	7 0 0
Sections	7 12 6	6 5 0
Steel Sheets, under 9/16in. to ½in.	10 10 0 to 11 10 0	
Sheets (Gal. Cor. 24 B.G.)	—	£16 15 0 to £17 15 0

STEEL (*continued*).

	Home.	Export.
	£ s. d.	£ s. d.
N.E. COAST—		
Ship Plates	7 17 6	—
Angles	7 10 0	—
Boiler Plates	11 10 0	—
Joists	7 10 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 10 10 0†	
MANCHESTER—		
Bars (Round)	9 5 0	—
,, (others)	9 0 0	—
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	8 2 6	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—	(*Nominal: none on offer.*)	
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	6 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 5 0	
Billets and Sheet Bars	6 2 6 to 6 7 6	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 0 0 to 17 10 0	
Angles	7 2 6 to 7 10 0	
Joists	7 2 6 to 7 10 0	
Tees	8 2 6 to 8 10 0	
Bridge and Tank Plates	7 17 6 to 8 2 6	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	25/3 to 26/-
Block Tin (cash)	278 5 0
,, (three months)	277 17 6
Copper (cash)	57 17 6
,, (three months)	58 12 6
Spanish Lead (cash)	31 8 9
,, (three months)	31 8 9
Spelter (cash)	34 7 6
,, (three months)	34 10 0
MANCHESTER—	
Copper, Best Selected Ingots	64 5 0
,, Electrolytic	66 5 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 0½
Brass Tubes (Basis Price)	0 0 11½
,, Condenser	0 1 2
Lead, English	33 2 6
,, Foreign	31 17 6
Spelter	34 17 6

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£38 10 0	12/6
,, ,, 1 p.c. ,,	£44 10 0	15/-
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5½d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 5 0 unit	scale 5/- per
,, ,, 75 p.c.	£20 10 0 unit	scale 6/- per
,, Vanadium	15/- per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/- per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND. (*Prices nominal.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/9
,, ,, Ell	16/6
,, ,, Splint	16/6 to 17/-
,, ,, Trebles	15/9
,, ,, Doubles	14/- to 14/6
,, ,, Singles	13/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	16/9
,, ,, Jewel	17/- to 17/6
,, ,, Trebles	17/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/9
Screened Navigation	21/-
Trebles	14/- to 15/-
Doubles	14/-
Singles	13/- to 13/6
LOTHIANS	
(f.o.b. Leith)—Best Steam	14/- to 14/3
Secondary Steam	13/6
Trebles	14/6 to 14/9
Doubles	13/6
Singles	13/6

ENGLAND.

(8) N.W. COAST—	
Steams	*No quotation*
Household	,, ,,
Coke	,, ,,
NORTHUMBERLAND—	
Best Steams	16/-
Second Steams	14/6 to 15/-
Steam Smalls	8/- to 8/6
Unscreened	13/- to 13/6
Household	20/- to 22/-
DURHAM—	
Best Gas	18/6 to 19/-
Second	15/- to 15/6
Household	20/- to 22/-
Foundry Coke	18/- to 20/-

SHEFFIELD	Inland. (*Nominal: none on offer.*)
Best Hand-picked Branch	31/- to 34/-
Barnsley Best Silkstone	28/- to 30/-
Derbyshire Best Brights	26/- to 28/-
,, ,, House	24/- to 25/-
,, ,, Large Nuts	17/- to 20/-
,, ,, Small	12/6 to 14/-
Yorkshire Hards	17/- to 19/6
Derbyshire Hards	16/- to 19/-
Rough Slacks	10/- to 12/6
Nutty Slacks	7/6 to 9/-
Smalls	3/6 to 6/-
Blast-furnace Coke (Inland)*	—
,, ,, (Export) f.o.b.	16/- to 17/-

CARDIFF— (9) SOUTH WALES. (*All prices nominal.*)

Steam Coals:	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/- to 25/-
Ordinary Dry Large	21/- to 22/-
Best Black Vein Large	25/6 to 26/-
Western Valley Large	24/6 to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary ,, ,,	23/6 to 24/-
Best Steam Smalls	17/- to 18/-
Ordinary ,,	16/- to 17/-
Washed Nuts	19/- to 20/-
No. 3 Rhondda Large	26/6 to 27/-
,, ,, Smalls	18/- to 18/6
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 21/-
,, ,, Smalls	15/- to 16/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	32/6 to 33/6
Pitwood (ex ship)	26/6 to 27/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	30/- to 40/-
Seconds	32/6 to 35/-
Red Vein	27/- to 29/-
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	42/6 to 44/-
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/-
Smalls	11/- to 15/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market 17/6 to 19/- at ovens. † Latest quotations available. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham

French Engineering Notes.

(From our Correspondent in Paris.)

The Franc and Trade.

If the collapse of the franc has stimulated a foreign demand, it is certain that its effects have been disastrous in other directions, and, even for export, makers are obliged to look more closely to their quotations in order to provide for the replacement of raw material at much higher prices. On the home market the situation has become so complicated that manufacturers are completely changing their usual methods. The whole situation is being carefully examined by the various makers' associations with the idea that, unless trading methods are adapted to the new conditions, this country may find itself in the same position as the central European Powers at the time of the ruinous monetary inflation. Meanwhile, the committee of experts, which has reported upon the financial situation, declares that one of the factors in a recovery is a considerable increase in the country's production. This refers particularly to the operations of the eight hours' day, which is responsible for the lower individual production and also for the dearth of labour, followed by the importation of foreign labour that is now beginning to develop into a serious social problem. There is not yet any appreciable unemployment, but the fear that a falling off in business activity may throw men out of work has induced the Government to take measures for the protection of French workmen, in the sense that employers must always in future take them in preference for foreigners.

The Alsace Canal.

A commission of the Chamber of Deputies has prepared a report which is entirely favourable to the immediate granting of a concession for the construction of the first part of the Alsace Canal, with an hydro-electric installation at Kembs, to the Société des Forces Motrices du Haut-Rhin. The carrying out of this work is regarded as of great national importance, and, when the lateral canal between Huningue and Strasburg is completed, it is estimated that the eight hydro-electric generating stations will provide from 800,000 to 900,000 horse-power, which will be amply sufficient for the requirements of Alsace and the eastern departments. The first section of the canal to be constructed will begin on the left bank of the Rhine at about 5 kiloms. from the Swiss frontier. It will have a length of 5·6 kiloms. The width at the water level will be 8 m. and the depth 10 m. The turbines at the Kembs power station will develop 120,000 horse-power, but only one half of that power will be available during the five months of low water. There will be two locks capable of accommodating a tug and two barges of 1200 tons. The canal back from Kembs to the Rhine will have a length of 1150 m., and will be enlarged near the power station to form a dock for boats. When the second section of the Alsace Canal is completed, the return canal will be filled in. The dam, which is to maintain the level of the Rhine for supplying the canal, will be constructed about 500 m. below the point where the canal joins the river.

Rail Union.

The difficulties that retarded the constitution of the Rail Union have been overcome, and at the next meeting, to be held in London during August, the agreement will be signed. The differences between the British and continental rail makers have been adjusted by an arrangement whereby continental firms will not be able to send rails to South Africa and India until the British makers have received their full quota of foreign orders. As was the case with the old Union, the distributing bureau is to be in London, and there will be four delegates, representing Great Britain, France, Belgium, and Germany. The pre-war Union was known as the Irma, and that name has now been changed to Erma, to show that it is a European and not an international organisation.

An Old Suspension Bridge.

The towns of Tain and Tournon, on opposite banks of the Rhone, are proud of being connected by the first suspension bridge which was built across the river by Marc Séguin in 1826. They celebrated the centenary of the bridge last week in the presence of descendents of the great engineer. Marc Séguin undertook the work after he had experimented with a much smaller structure across the Cance three years previously, and the bridge across the Rhone, which is still in excellent condition, was the first in this country to be suspended from cables.

Tin-plates.

A tin-plate industry has had to be developed in this country owing to the difficulty of procuring supplies from Wales under the present monetary conditions, and the industry may be regarded as definitely established now that producers of tin-plates have organised a Chambre Syndicale de Forges productrices de fer-blanc.

The Dockers' Strikes.

There is no change in the situation at the ports. The strike at Antwerp caused considerable trouble, and 250 ships were laid up there. The Belgian sailors refused to help in loading and unloading cargoes, the work being done as far as possible by British and French sailors. At Dunkirk and Boulogne the dock committees refuse to discuss matters with the men until they return to work. The dockers' agitation is an inevitable consequence of the rapidly increasing cost of living through the currency inflation, and it is being strongly resisted because, if employers give way now, there will certainly be a heavy inflation of wages all round. The main object in endeavouring to stabilise the franc without loss of time is to prevent wages from advancing so rapidly that it will be impossible to get them back again to a level corresponding with normal costs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

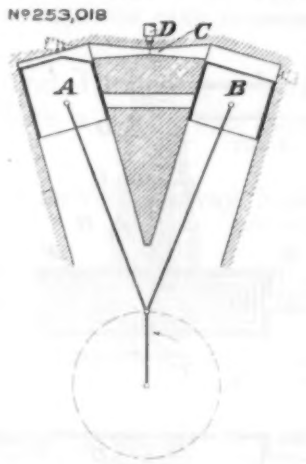
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

253,018. April 3rd, 1925.—High-compression Engines, *R. Haddan*, 31, *Bedford-street, Strand, London, W.C.* 2.

This invention is concerned with engines in which there are two intercommunicating cylinders with pistons working on a common crank. The clearances are so arranged that at the top

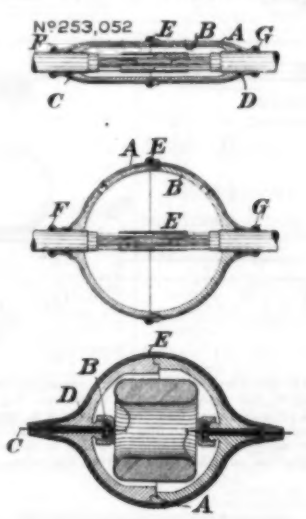


of the stroke the piston A produces a higher compression than does the piston B. There is consequently a strong flow of air through the communicating passage C from A to B, and this flow carries with it the fuel injected at the point D. By these means, it is claimed, the mixture of the fuel and air is improved. —*June 10th*, 1926.

TELEGRAPHS AND TELEPHONES.

253,052. March 8th, 1926.—An Improved Pressure-resisting Casing for the Accommodation of the Coils for Submarine Cables. Felten and Guilleaume Carlswerk Actien-Gesellschaft, of Köln-Mülheim, Germany.

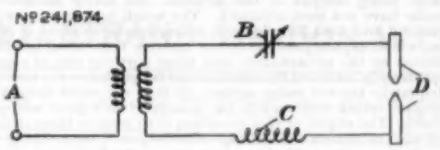
The invention relates to a pressure resisting protective casing for the accommodation of the connections or self-induction coils of submarine cables which are laid at great depths. The two upper drawings show constructional examples of an elongated and a spherical casing of light metal, as applied to a lead-covered cable. The lead sleeve A and the pressure-resisting casing B consist of two bell-shaped parts which are first slid on to the two cable ends. After the conductors have been jointed or after the insertion of the coils, the parts B of the pressure resisting casing are pushed together, and are soldered to the lead cover of the cable at the places C and D, and are soldered



together in the middle at E. The two halves A of the lead sleeve are thereupon pushed over the pressure-resisting casing, and are first soldered to the lead cover of the cable F and G, and are finally soldered to each other at E. The lower drawing shows a constructional example of the pressure-resisting protective casing of light metal for gutta-percha cables. In order to obtain a mechanically sound and water-tight connection between the casing and the cable from the interior of the casing, which is divided at A, the insulation is pressed by means of the cap nut B between the entering conical copper conductor C and the fluted wall of the casing D, which at this part is elongated. For preventing water penetrating through the wall of the casing the outside of the casing is covered with gutta-percha forming a continuation of the gutta-percha covering of the cable where it enters the casing.—*June 10th*, 1926.

241,874. September 23rd, 1925.—Method of Converting Electrical into Acoustic Energy without Inertia, Dr. Heinrich Könemann, of 4, Gereonstrasse, Münster in Westphalia, Germany.

The modulated high-frequency energy is supplied to the terminals A, it being supplied, for example, by a thermionic valve. B and C are tuning elements, D the air gap between the electrodes arranged vertically one above the other. These may consist of two electric light carbons. In operation, the rate of production of heat in the air gap varies with the intensity of the high-frequency current. Fluctuations in the density of the

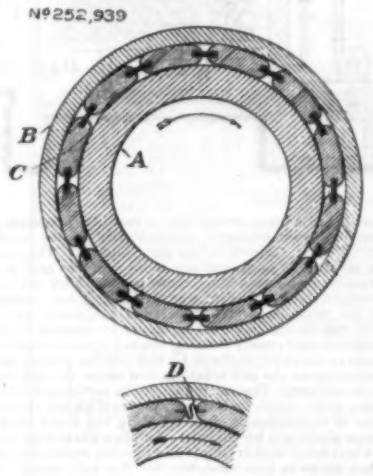


surrounding air are thus produced. By reason of the high-frequency, however, they are not perceived by the ear. It is only when the high frequency is modulated by some device that the ear perceives the superimposed sound frequencies. As shown by experiment, the sound is very loud. If there is no modulation, the arc burns silently in spite of the passage of the high-frequency alternating current.—*June 10th*, 1926.

TRANSMISSION OF POWER.

252,939. August 18th, 1925.—Bearings, W. Hulsebos, Laren, near Hilversum, Holland.

In this bearing the load is transmitted from the journal A to the shell B by means of a series of loose pads C. These pads

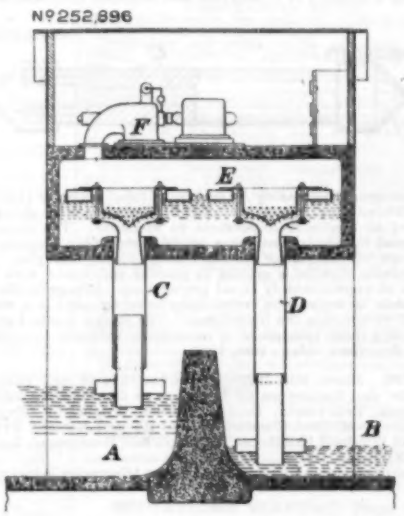


are connected together by means of springs, such as that shown at D, in such a manner that they are given a tilt and provide a wedge-shaped entrance for the lubricant after the fashion of the Michell bearing.—*June 10th*, 1926.

PUMPING AND BLOWING MACHINERY.

252,896. June 2nd, 1925.—Hydraulic Air-inspiring Plants, J. O. Boving, Station House, Victoria-street, Westminster.

This invention is put forward as a means of utilising tidal energy, but might be used in other directions where large quantities of air have to be handled. The two compartments of the tidal basin are shown at A and B, and are connected by means of the inverted syphon pipes C D and the closed chamber E. As



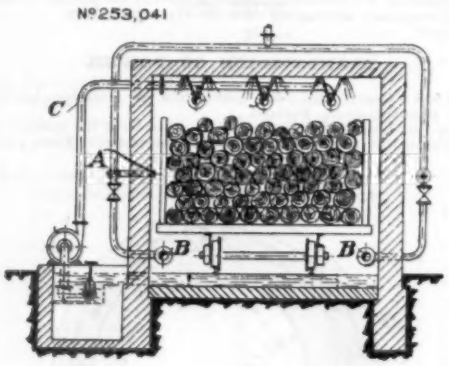
shown in the drawing, water flows up the branch C and down the branch D. In doing so, it inspires air from the chamber E and reduces the pressure there, so that the turbine F may be operated by the admission of air from the atmosphere. When the tide changes, the functions of the two tubes C and D are reversed, but the running of the turbine is unaffected. It will be noticed that the tubes have telescopic ends to accommodate the varying level of the tide.—*June 10th*, 1926.

MISCELLANEOUS.

253,041. February 23rd, 1926.—Preserving Wood by Impregnation, Gebr. Himmelsbach Aktiengesellschaft, Freiburg, Baden, Germany.

Wood which is to be impregnated with a salt, for example, with mercury chloride, sodium fluoride, zinc chloride or the like,

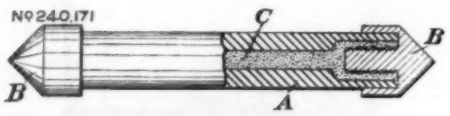
is generally air dried when it is placed in the salt solution, and the solution then penetrates very slowly into the dry outer layer, the time required for the treatment being, say, from eight to ten days. Moreover, salt becomes firmly deposited in the outer layer, and renders it difficult for additional salt to penetrate more deeply into the wood. In some cases the wood has been steamed or treated with vapours containing acid or cresol before being steeped in the solution, but really satisfactory results have not been obtained. The wood, for example, when kyanized and used for telegraph poles, develops cracks of some size, which expose portions of the interior that have not been affected by the preservative, and these portions are, of course, more readily attacked by moisture and fungi, and so on, than the adequately treated outer surface, so that the wood frequently becomes rotten inside while the outside is still quite well preserved. The object of this invention is to remove these defects and also to reduce the average time required for steeping the wood. According to the invention, the wood is first steamed very strongly at a high temperature, so as quickly to heat it and moisten the outer layer, which is generally drier than the interior, and then the wood is briskly dried, at a temperature up to about 150 deg. Cent., generally by means of hot air, so as artificially to produce cracks or crevices, whereupon the wood



is treated by steaming or the like, sometimes accompanied by hot spraying, maintaining it substantially at the same temperature till it is steeped in the salt solution. The cracks or crevices artificially produced are more uniform and generally more densely distributed than those produced by drying without previous steaming, probably because when steaming is omitted the moisture in the interior of the wood, which is in excess of that in the outer layer, tends to produce large, irregularly distributed cracks forming vents for the issuing vapour. The cracks or crevices produced by this process greatly facilitate the penetration of the salt solution, and cause the impregnation to be more uniform. The steaming may be performed with steam containing acid, cresol or hexanol, or homologues thereof, and the water of condensation, impregnating the wood renders the latter more absorbent for the salt. Another advantage of steaming the wood after well drying it and in some cases also spraying it, is that there is less tendency for the salt unduly to clog the outer layer and prevent adequate penetration of the solution to the interior. The solution thoroughly impregnates the walls of the crevices, so that if these crevices, which generally close up after treatment, open again when the wood is exposed to air, that does not result in exposing untreated surfaces of the wood. The illustration is a cross-section through a kiln for carrying out the process, in which the steam is admitted directly by the branch A. B B are radiator pipes for the drying operation, and C is the supply of preserving solution.—*June 10th*, 1926.

240,171. September 18th, 1925.—IMPROVEMENTS IN AND RELATING TO ELECTRICAL RESISTANCE DEVICES AND METHOD OF MAKING SAME, *Dubilier Condenser Company (1925), Ltd., of Ducon Works, Victoria-road, North Acton, London, W. 3.*

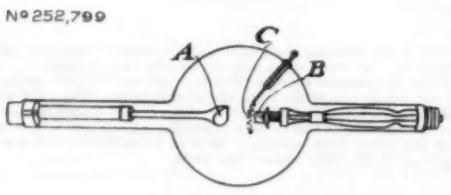
For many electrical purposes resistances ranging from a few thousand ohms to several megohms are required. These resistances should have relatively high current-carrying capacity and should not change materially with a rise or fall in temperature. According to this invention, such resistances are made by forcing a mixture of conductive and adhesive substance into a



porous insulating casing A, such as a tube, which is closed by conductive caps B, and the device is subsequently dried and coated to render it impervious to moisture. The resistance material C, which contains a binder, preferably consists of a mixture of manganese dioxide, lamp black, and glue. The manganese dioxide is ground to powder and mixed with lamp black in approximately equal proportions. Lepage liquid glue can then be added, the entire mass being agitated in a stirring vessel to intermix the ingredients. The precise method of constructing these resistances in accordance with the invention is fully described.—*June 10th*, 1926.

252,799. March 6th, 1925.—IMPROVEMENTS IN AND RELATING TO THE RECEPTION OF PICTURES IN COPYING-TELEGRAPHY AND TELEVISION, George Maurice Wright, of Lyngrove, Cromwell-road, Chesterfield, and Richard Norman Vyvyan, of Windmill Hill House, Windmill-hill, Hampstead, London, N.W. 3.

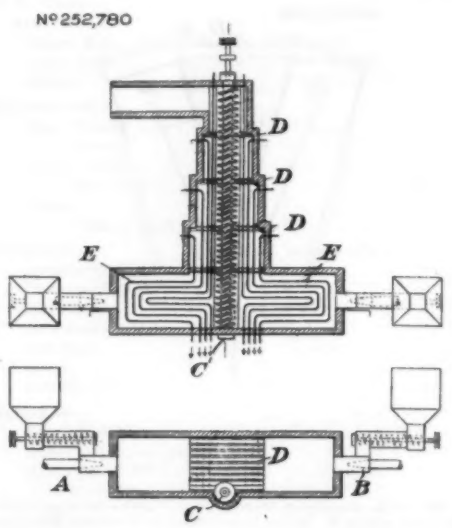
One of the main difficulties in picture telegraphy is to transfer



the variation of potential or current in the receiver, resulting from the light and shade of the transmitted picture to a sensitive photographic surface or to a prepared screen with extreme rapidity. In the past, moving mirrors, pens, &c., have been proposed and employed, but they all have mechanical inertia, which renders them unsuitable for high-speed picture telegraphy or television. According to this invention, an X-ray emitting device is employed, and means controlled by the received electrical variations for controlling the intensity of the emitted rays. Preferably an X-ray tube with a heated cathode and a controlling grid between the cathode and the target is employed. The potential variations in the receiving circuit are transferred by a suitable amplifier to this grid, and thereby the electron flow in the X-ray tube and consequently the intensity of the emitted X-rays repeat these variations. The X-rays may then be caused to act through suitable slits upon a photographic surface, or for television upon a fluorescent screen. In the drawing, A is a target anode and B a heated cathode within a focussing screen of the kind usually employed in X-ray tubes of the so-called "Coolidge" type. C is a grid projecting into the path of the rays between the cathode and the target. The potential variations in the receiving circuit are applied to the grid and serve to control the intensity of the emitted X-rays, which are caused to act through suitable slits upon a sensitised surface or upon a fluorescent screen.—*June 7th*, 1926.

252,780. March 3rd, 1925.—CEMENT AND LIME BURNING, G. E. Heyl, 36, Victoria-street, Westminster.

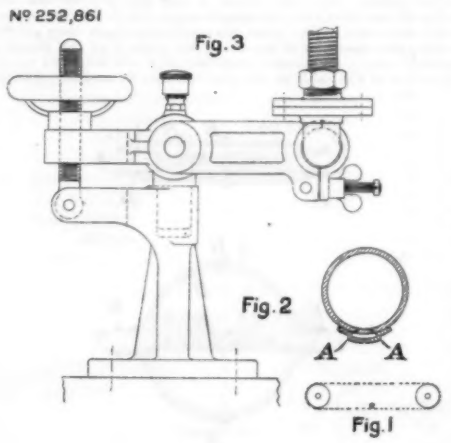
The inventor proposes to manufacture Portland cement by blowing the powdered cement-making mixture into a flame produced by burning powdered coal. The flame temperature is



put at 1500–1600 deg. Cent. In the drawing the burner jet is shown at A and the mixture jet at B. The vitrified material is carried away by the conveyor C. D D D are baffles in the outlet flue to assist in the precipitation of the material, while E E are water-circulating pipes for cooling the floor of the chamber.—*June 3rd*, 1926.

252,861. May 4th, 1925.—CLEANING THE MACHINE WIRE OF PAPER-MAKING MACHINES, E. Kempter and Sons, George-street, Bury, Lancs., and W. Hoyle, 3, Snape-street, Darwen.

The inventors propose to clean the "machine wire," or mesh, of paper-making machines by means of high-pressure steam jets applied to the lower stretch of the wire, as indicated in Fig. 1.



The jet takes the form of a thin film emerging from a pipe arranged across the machine. The pipe—see Fig. 2—is perforated, and provided with two brass plates A A, spaced a short distance apart to produce the film. The pipe is mounted on the ends of two swinging levers, one of which is shown in Fig. 3, so that it may be adjusted to and from the wire.—*June 10th*, 1926.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE Governors of Sir John Cass's Foundation have appointed Mr. Geo. Patchin, A.R.S.M., as principal of the Sir John Cass Technical Institute, London, in place of Dr. Charles A. Keane, resigned.

A. HARPER, SONS AND BEAN, Ltd., of Rolfe-street, Smethwick, Staffs., ask us to announce that the style of the company has now been altered to Bean Cars, Ltd. This alteration in name applies equally to the drop forging works at Smethwick.

MR. A. M. JACOBS, M.A.I.E.E., an Electricity Commissioner, Union of South Africa, is on a visit to this country, and his address during his stay in this country will be c/o International Combustion, Ltd., Africa House, Kingsway, London, W.C. 2.

MR. LOUIS JOHN HUNT, M. Inst. C.E., M.I.E.E., of 4, Broad-street-place, London, E.C. 2, informs us that the Electric Construction Company, of Wolverhampton, has acquired the electrical business of Sandycroft, Ltd., and that he has entered into an agreement with the Electric Construction Company to act in a consulting capacity to it in connection with cascade induction and synchronous motors and self-paralleling alternators.

THE POWER PLANT COMPANY, Ltd., of West Drayton, Middlesex, asks us to state it has acquired an exclusive licence for the manufacture and sale of the Richards thread milling machines, and intends to introduce new and improved models in addition to those now on the market.

HENRY BUTCHER AND CO., engineering auctioneers, of 63 and 64, Chancery-lane, London, W.C. 2, ask us to announce that they have admitted into partnership with them Mr. Charles Fuller Hall, a fellow of the Auctioneers' Institute. The business will be continued under the new style of Henry Butcher, Hall and Co.

NEWTON, CHAMBERS AND CO., Ltd., of Thorncliffe Ironworks, near Sheffield, inform us that they have acquired the sole patent rights of the Hurst-Ball centrifugal casting process, and the plant for the production of casting by that process, from Centrifugal Castings, Ltd., Kilmarnock, and have started a Thorncliffe Centrifugal Castings Department in their works. The plant is now in the course of re-erection and will shortly be ready for production.

A JURY, consisting of Mr. H. V. Lanchester, F.R.I.B.A., Mr. Arthur Davis, F.R.I.B.A., Mr. C. L. Gill, F.R.I.B.A., Professor A. E. Richardson, F.R.I.B.A., and Mr. Corfiato, A.R.I.B.A., has awarded the *Concrete and Constructional Engineering* Prize for concrete design to Miss Jessie M. Greig. The prize, of the value of £25, is awarded annually by Concrete Publications, Ltd., to further architectural interest in reinforced concrete. The designs this year were for a reinforced concrete pavilion.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, JULY 17TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to works of Hartley and Sugden, Ltd., Halifax, postponed from May 15th. 2.30 p.m. at the works.

MONDAY TO FRIDAY, JULY 19TH TO 23RD.

CONGRESS OF CHEMISTS.—In London. For programme, see page 646.

WEDNESDAY, JULY 21ST.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting at Gosport. 2.15 p.m.

SATURDAY, JULY 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Joint meeting of the South-Eastern and Metropolitan Districts at Kemsley village, near Sittingbourne. Motor coaches leave Charing Cross Underground Station (Embankment), 10 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting at Paignton. 11 a.m.

CONTRACTS.

THE STREAM-LINE FILTER COMPANY, Ltd., of 64, Victoria-street, Westminster, S.W. 1, has received from H.M. Admiralty an order for a Stream-Line separator to deal with 200 tons per hour under guarantee of less than one part of oil in 200,000 of water. It is to be fitted to a lighter to pump out oily bilge and ballast water from vessels using Devonport Harbour.

THE RANSOME MACHINERY COMPANY (1920), Ltd., of Windsor House, 42–50, Victoria-street, London, S.W. 1, has received an order for two further No. 3 size (1 cubic yard) electrically-driven Ransome rotary-drum concrete mixers for the Sutlej Valley irrigation works, India. This makes a total of fourteen concrete mixers of the same size which the firm has supplied for work on this scheme.

MR. JOHN T. PICKLES, of Mytholm House, Hebden Bridge, informs us that (*a*) he has just received a cable message from South America containing a repeat order for a band saw tree feller, cross-cut and log miller for breaking down and flitching logs up to 4ft. in diameter; and (*b*) that he has recently executed an order for a similar forestry sawing equipment for one of the South American railways.

CAMMELL LAIRD AND CO., Ltd., Nottingham, have received an order from the London and North-Eastern Railway Company for two additional Sentinel-Cammell coaches and thirty-four all-steel luggage brake vans. The firm's associated company, the Midland Railway Carriage and Wagon Company, Ltd., Birmingham, has also received an order from the London and North-Eastern Railway for four articulated trains comprising thirty-two coaches in all.

JOHN I. THORNYCROFT AND CO., Ltd., have received an order for twenty-three of their "A1" type six-wheeled vehicles and a "Hathi" tractor for use in the Sudan. Eighteen of the vehicles are to be fitted with platform bodies and to have two-wheeled trailer attachments to carry 20-cwt. loads. The "Hathi" tractor is to be capable of crossing gullies with vertical banks 3ft. in height, of exerting a steady draw-bar pull of 9000 lb., of hauling a 10-ton trailer load up a gradient of 1 in 10 at 7 miles per hour, and of travelling through soft sand.

WORTHINGTON-SIMPSON, Ltd., London and Newark-on-Trent, have secured the order for a surface condensing plant for the 15,000-kilowatt turbo-alternators installed in the Leicester Corporation electricity station at Freemans Meadow. The plant is to consist of twin condensers with duplicate steam air ejectors, duplicate circulating and extraction pumps, motors, starters, feed-water heaters, piping, &c. The same firm has also secured the following orders for:—(*a*) a vertical triple-expansion rotary pumping engine capable of delivering 5,000,000 gallons per day against a total head of 200ft., the order including Lancashire boiler, piping and accessories, the complete plant to be erected on site for the Howrah Waterworks, India; and (*b*) a horizontal uniflow surface condensing steam pumping engine with direct-acting pumps to deliver 360,000 gallons per day against a head of 1100ft., for the Ali Musjed pumping station, Khyber Pass, India, the plant being a duplicate of one previously supplied.